America's Great Climate Migration Has Begun. Here's What You Need to Know.

Columbia researchers are developing innovative ways to protect communities most vulnerable to floods and other disasters.

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For people whose lives have been turned upside down by climate change, who have survived wildfires and droughts, lived through hurricanes, and experienced unrelenting heat or unprecedented floods, it is a last-ditch survival strategy: you pull up stakes and move.

Around the world, people are now routinely fleeing their homes to escape the effects of global warming. In the African Sahel, a semi-arid region that sits south of the Sahara, altered rainfall patterns are causing farmers to throw down their tools and seek refuge in cities. In Honduras, Nicaragua, and El Salvador, prolonged droughts are killing crops and prompting impoverished families to set out in search of more fertile ground. In Southeast Asia, the rising sea is inundating rice paddies, forcing farmers to quit their livelihoods and retreat inland.

There's no doubt that the climate crisis disproportionately affects poor countries. Populations that depend on farming or fishing are extraordinarily vulnerable to nature's whims. Indeed, one report by the World Bank, coauthored by Columbia geographer Alex de Sherbinin, predicts that more than two hundred million people in low-income countries may migrate as a result of climate change by 2050.

But could Americans experience similar upheavals? Could we, despite our relative wealth and long history of bending nature to our will, one day find that large sections of our country have become uninhabitable?

"We'll likely see population shifts in the US in the coming decades because of climate change," says de Sherbinin, who directs the Columbia Climate School's Center for International Earth Science Information Network (CIESIN) and teaches a course on climate migration. "Not everybody is necessarily going to go far. But we could see significant movements, probably away from the coasts and toward the north."

According to de Sherbinin, some studies have indicated that tens of millions of Americans could be uprooted by global warming this century. However, there is great uncertainty about how many people may move and when, in part because individual decisions about whether to migrate are highly complex, involving not just environmental factors but economic, cultural, and social ones. "In other countries, we've observed that climate change is rarely the sole reason people decide to relocate," says de Sherbinin, who has led several landmark studies on global migration patterns. "If people still have their livelihoods and there's infrastructure to keep them reasonably safe, they'll often stay and try to adapt, even in the face of pretty extreme environmental pressures." So the amount of migration that we should expect to see in the US, he explains, will be strongly influenced by the public investments we make in supporting and protecting people in the least hospitable places. "The big question then becomes: how many resources do we put into adaptation efforts, and for whom?"

One thing that climate scientists know for sure is that America's natural environment will be utterly transformed by mid-century, with profound implications for people's health, safety, and quality of life. This will be true even under optimistic climate scenarios, such as if the world's largest economies accelerate their transition to renewable-energy systems and hold average global temperatures to five or six degrees Fahrenheit above preindustrial levels. Scientists now know with a fair degree of certainty, for example, that sea levels will rise one to two feet along the Gulf Coast and Eastern Seaboard by 2050, putting millions of homes at risk for regular flooding. "We'll probably figure out ways to protect large sections of New York City, Boston, and Miami, because they contain huge numbers of people and billions of dollars in infrastructure, but countless other coastal communities situated in between major cities are going to have a more difficult time adapting," de

Sherbinin says. "State and local governments don't have the resources to build seawalls around every seaside town. So all along the coasts you're going to see homeowners and businesses trying to relocate. And where residents are too poor to move, we may see stranded assets as insurers pull out."

Also by mid-century, climate scientists expect that large sections of the West will be turning into desert, that the Great Plains and the South will be stricken by heat waves and oscillating periods of drought and flooding that will make farming much less productive, and that parts of the South will be so hot and humid in the summertime that it will be dangerous to go outdoors. Climate models suggest that the heat index or "real feel" temperature — which describes the combined effects of heat and humidity — could regularly exceed 130 degrees Fahrenheit in many southern states, a level that has rarely been observed anywhere and that is life-threatening even to strong, physically fit people at rest.

Solomon Hsiang '11SIPA, an economist who studies the effects of rising temperatures on human behavior, has argued that such extreme conditions could soon cause large numbers of people to leave the South, the Midwest, and the West. "People will definitely move. The question is just whether we'll see this happen in the next few decades, given the current rate of warming," says Hsiang, who conducted groundbreaking research as a Columbia graduate student and is now a professor at the University of California, Berkeley. He points out that extreme heat has been shown to decrease economic productivity in agriculture, manufacturing, and many other industries, which may lead businesses to relocate from the hottest parts of the US, with workers likely to follow. "At first, we'll probably see an outflow of people in their twenties and thirties, who tend to be the most mobile," he says.



Americans are beginning to reconsider settling in the Southwest because of extreme temperatures and dwindling water supplies. (Mario Tama / Getty Images)

Global warming is already causing subtle demographic shifts in the US. Climate-driven natural disasters like wildfires, hurricanes, and floods — which have all grown more frequent, intense, and destructive this century — now force two to three million Americans from their homes annually, and Census Bureau surveys indicate that many displaced people are choosing to permanently relocate out of harm's way. The US government is also actively encouraging people to clear out of vulnerable areas. The Federal Emergency Management Agency (FEMA) has in recent years ramped up its efforts to acquire properties that routinely flood, many of which are being restored to estuaries, marshes, and wetlands that act as natural buffers against future storms. Meanwhile, old industrial northern cities, from "Climate-Proof Duluth," Minnesota, to Burlington, Vermont, are billing themselves as "climate havens" in an effort to lure newcomers and revitalize their economies.

"Northern states could see an influx of people, because their summers will still be fairly pleasant and their winters less severe," says de Sherbinin. Particularly well-positioned geographically, he says, are states near the Great Lakes, since fresh groundwater will be an increasingly precious resource as the planet warms. De

Sherbinin frequently gives lectures in New England and the Great Lakes region about the need for policymakers and urban planners to prepare for the arrival of climate migrants. "Cities and towns throughout these regions could benefit economically and culturally," he says. "But they need to start planning to provide housing, education, health care, and other services for more people."

The total number of Americans who might already be considered "climate migrants" is modest but growing. This past winter, Jeremy Porter, a sociologist who teaches at Columbia's Mailman School of Public Health and at CUNY, published one of the first empirical studies on the subject. In a paper in the journal *Nature*, he and colleagues revealed that approximately 3.2 million people in the US have moved in an effort to escape flooding over the past two decades. In that time, climate change has made flooding worse across the entire country, not just along the coasts. "Inland communities that rarely faced flooding in the past are now getting washed out by heavier rainfall," says Porter, whose team used big-data techniques to confirm that flood risk was causing people to move out of their neighborhoods. "In response, people in just about every county are now fleeing low-lying areas."

Those who are leaving flood zones aren't necessarily going long distances. In fact, the majority of them are moving to higher ground in the same county, Porter found. But in a forthcoming paper, he and his colleagues reveal that homebuyers are starting to avoid entire states because of their vulnerability to wildfires, extreme heat, and windstorms. "Several of these states, like California, Texas, and Florida, are still experiencing population growth, but we found evidence that they're now growing more slowly than they would be if not for these climate hazards," says Porter. "Some people, it seems, are finally taking these risks into consideration when choosing where to live."

Could we one day find that large sections of our country have become uninhabitable?

You might wonder why it's taken them so long to do so. Climate scientists have for years been warning Americans that they are endangering themselves by settling in places like the parched, wildfire-prone woodlands of California and Nevada; the eroding coastlines of Florida and South Carolina; and the sweltering Southwestern states. Yet Americans have continued to flock to these places, causing their populations to grow dramatically in recent decades. They continue to do so today, notwithstanding the small deceleration in growth detected by Porter, despite the

costs in deaths and dollars. In 2023, the US experienced a record-breaking twentyeight climate and weather disasters that each caused \$1 billion or more in damages; these events killed nearly five hundred people.

Environmental journalist Abrahm Lustgarten '03JRN, in his new book, *On the Move:* The Overheating Earth and the Uprooting of America, considers why so many Americans live in high-risk locations and what it might take for them to leave. The reason for our current population distribution, he asserts, is largely economic, since US elected leaders, with the backing of financial institutions, have long encouraged the construction of homes just about anywhere possible, including in the paths of wildfires, hurricanes, droughts, and floods. For a long time, this aggressive development strategy paid off, because natural disasters were relatively rare and the costs of repairing properties when catastrophes did occur were easily shouldered by insurance companies. But in recent years, disaster-recovery costs have skyrocketed, causing insurance companies in California, Florida, and several other states to start losing money. Property owners have so far been largely insulated from these losses, says Lustgarten, because state leaders, fearing that a mass exodus of residents would destabilize their real-estate markets and shrink their tax base, have — through regulation and subsidy — prevented insurance companies from significantly raising their rates. But sooner or later, Lustgarten argues, homeowners in vulnerable areas will have to shoulder the true cost of their coverage, which will cause property values to plummet. In the meantime, he says, subsidy programs are giving homeowners a false sense of security, making them unaware of the full extent of their financial exposure.

"The cost of insurance is an indispensable signal," Lustgarten writes. "It's not the only tool that represents the risks of climate change, but just as an auto-collision policy is more expensive for a teenage boy than for an adult driver, a high cost for homeowners' coverage offers a clear, market-based sign of danger ... Subsidizing insurance distorts that warning signal. It minimizes the perception of the real risk that people face."

There are signs that the costs of climate hazards are pushing the US insurance industry to a breaking point. New York Times reporter Christopher Flavelle '09SIPA revealed in an investigative series this year that insurance companies are now routinely losing money on homeowners' policies in at least eighteen states — primarily because of wildfires, floods, and intensifying windstorms — and that in response many companies are refusing to sell or renew policies in certain at-risk

areas, leaving homeowners scrambling to find coverage. Some state regulators, in a desperate attempt to persuade the companies to continue to provide coverage, have permitted them to raise rates, which have jumped 50 percent or more in some areas, with further increases expected. Flavelle called the development "a flashing red light" for the US economy. Without affordable insurance, "banks won't issue a mortgage; without a mortgage, most people can't buy a home," he writes. "With fewer buyers, real-estate values are likely to decline."



Climate and weather disasters like Hurricane Beryl, which struck Houston in January, are growing stronger and more frequent. (Danielle Villasana for *The Washington Post* via Getty Images)

Lustgarten, in *On the Move*, predicts that the first big, conspicuous waves of climate migration in the US will begin when the bottom falls out of housing markets in the most vulnerable regions. If these markets do crash, he writes, they are likely to crash quickly, without much warning. And then, he writes, "a Darwinian game of financial survival" will ensue. Homeowners with enough cash liquidity to purchase new homes elsewhere will do so, and everyone else will be left with stranded assets, living in hollowed-out communities with less money for schools, police, and other basic services — let alone for floodwalls, wildfire barriers, and other adaptation measures that will be urgently needed.

"If that sounds unreasonably apocalyptic, it's almost exactly what leaders in Louisiana are right now warning about," Lustgarten writes. He notes that many parishes along the Gulf Coast have seen a flight of middle-class and wealthy residents in recent years; those left behind have watched their neighborhoods devolve into blight. "Many of the people who have remained in coastal Louisiana as others have left have no means to help their communities raise more money," he writes. "They themselves are desperately poor, their homes having lost so much value ... They would leave, too, if not for their inability to sell and get out."

Columbia faculty and students are leading dozens of projects aimed at helping people whose homes have become unlivable because of climate change, both in the US and around the world. Some Columbia teams are supporting people whose entire communities may need to be relocated, such as residents of small island nations vanishing beneath rising seas and members of Native American tribes situated along sinking US coastlines. Others are helping groups of homeowners in the paths of wildfires and hurricanes develop strategies to protect their neighborhoods. Still others are creating new analytic tools that enable policymakers to make more equitable and effective decisions about how to serve constituents in threatened areas.

"In all of this work, our goal is to ensure that the people who are the most vulnerable to climate hazards are prioritized for assistance and have a voice in shaping the solutions," says de Sherbinin, who chairs an interdisciplinary network of Columbia researchers who study issues related to climate migration and co-chairs a biennial conference on the topic. "If your neighborhood is constantly flooding and local officials are weighing whether to build a levee around it or encourage people to relocate, that's a decision that you should have a say in."

Many of the Columbia faculty and students working on these issues say they are motivated by a desire to advance environmental justice. It is well known that socioeconomically disadvantaged people are highly vulnerable to the effects of climate change. In the US, this is true especially of Black, Hispanic, and Native American people, who, because of a history of racist housing policies, are more likely to live in poorly landscaped urban neighborhoods, flood-prone coastal plains, and areas without adequate groundwater. Experts worry that people in such communities will also be shortchanged in future infrastructure projects that aim to protect people against heat waves, floods, and other climate threats.

"People who are wealthy, highly educated, and politically well-connected have traditionally been more successful in securing public investments to protect their neighborhoods against natural disasters, even if other neighborhoods face greater risks," says Paul Gallay '83SIPA, '84LAW, an environmental-policy researcher and director of Columbia's Resilient Coastal Communities Project.

Gallay's job is to break this cycle in the New York City region, specifically with regard to flood mitigation. The Resilient Coastal Communities Project, a partnership between the Columbia Climate School's Center for Sustainable Urban Development and the nonprofit New York City Environmental Justice Alliance, was launched in 2021 to promote equitable solutions to flood risks. It does so by conducting research on past flood-prevention projects and determining how such efforts can be made fairer and more effective in the future. Most importantly, it serves as a public watchdog over the US Army Corps of Engineers' massive effort to design and erect a new system of flood barriers in the New York metro area. The \$50 billion project, which is the largest of its kind ever attempted in the US, has been in the planning stages for years. The Corps has twice publicly unveiled proposals; its most recent plan, released in 2022, called for fifty miles of floodwalls, levees, and berms to protect New York City — or at least the most economically vital parts of it. The Corps, using a conventional cost-benefit methodology that prioritized the city's most valuable real estate, recommended leaving many low-income neighborhoods unprotected. The plan, which also called for unsightly, twelve-to-twenty-foot-high walls that would surround much of the city's waterfront, blocking street-level views of New York Harbor and the Hudson and East Rivers, was widely maligned. In response, Gallay helped to lead a coalition of community groups that, in partnership with state and city leaders, successfully petitioned the Corps to go back to the drawing board. Now the Corps is preparing to work up a third draft of its epic plan, giving equal weight to economic, social, and environmental considerations. To help keep the agency on track, Gallay and his colleagues at the Resilient Coastal Communities Project are helping to organize a new committee of environmentaljustice advocates who will advise the government engineers on behalf of underserved communities throughout the region.

"One of the things we'll be pressing for is protection against a broader spectrum of flood risks," says Gallay, an attorney and a past president of the New York environmental organization Riverkeeper. He says that previous versions of the Corps's plan focused exclusively on holding back coastal storm surges, but many New Yorkers also need protection against floods that regularly occur in their neighborhoods during heavy rainstorms or high tides. "We'll also be calling on the engineers to expand the use of natural flood-protection measures like wetlands and reefs."

But inevitably, no matter how well it is managed, the Corps's ambitious project will be unable to protect every New York City block. The total area of the city that is vulnerable to flooding is expected to expand significantly by the year 2100, affecting some 2.2 million residents, and there is simply not enough money available to build seawalls around every neighborhood and to elevate every street and sidewalk that needs it. Consequently, the specter of mass relocations hangs over the planning process; other cities that have undertaken massive flood-protection projects, including New Orleans, have orchestrated the "managed retreat" of residents out of low-lying areas that were deemed impossible to protect. These relocations have generally been induced via voluntary property-buyout programs, although during the Trump administration, cities that received federal funds for buyouts were told they had to back up the offers by threatening the use of eminent domain. Gallay says that few New Yorkers he has spoken to in vulnerable neighborhoods have expressed any interest in leaving their homes. "They're more interested in finding creative ways to keep their neighborhoods safe," he says. "They don't want to talk about managed retreat. They want to talk about strategies to stay."

Nevertheless, Gallay recently developed a set of guidelines for municipalities to follow should they choose to encourage residents to move out of high-risk areas. The bottom line: people whose future is at stake should be front and center at every stage of the planning process. "Nobody should be told, 'Pick up and move.' It's not moral, ethical, or practical," he says. "And ensuring that people have affordable housing available to go to if they do agree to move is paramount."

Gallay is concerned for renters, too. He notes that while public conversation about climate migration tends to focus on homeowners, rates of property ownership are quite low in cities, particularly in historically redlined districts where mortgage-lending practices once prevented Black and brown people from buying homes, accumulating wealth, and passing it down to their children. Yet kinship and social ties are extremely tight in many of these same neighborhoods, which can make the shuttering of apartment buildings terribly disruptive. "So a well-designed buyout program should ensure that if the owner of an apartment building is offered a buyout, protocols are in place so that tenants have their voices heard and their

interests taken into consideration," Gallay says. "They deserve a seat at the table."

Several Columbia researchers have stepped out of their professional comfort zones to study climate migration. Marco Tedesco, a prominent glaciologist known for his groundbreaking work on the physical dynamics of melting ice sheets, remembers the exact moment he decided to broaden the scope of his research and investigate how rising sea levels and other climate hazards are affecting US population dynamics. While driving to work one morning in the spring of 2021, he heard an NPR segment about "climate gentrification," which is said to occur when wealthy people move out of at-risk areas and into nearby neighborhoods that were previously considered less desirable, driving up rents and pricing out poorer longtime residents. "There was anecdotal evidence that this was starting to happen but no hard data to prove it," Tedesco says. "I thought to myself: I've spent decades studying the long-term impacts of ice melt and rising seas, but there are people being harmed right now. I have to help them somehow."

Over the next few months, Tedesco developed a novel analytic tool that enables researchers to identify neighborhoods that are especially vulnerable to climate gentrification and other forms of climate displacement. The Socio-Economic, Physical, Housing, Eviction, and Risk (SEPHER) dataset, as it is called, brings together huge amounts of information about climate hazards, real-estate trends, eviction rates, and residents' demographics and housing situations in every US census tract. Tedesco made SEPHER freely available online in late 2021 and soon after published a case study, based on his own analysis of data from Miami showing that climate gentrification is real: as flood risks have increased on the Miami waterfront, rent prices and evictions have surged in low-income districts perched on higher ground a few blocks inland. "Traditionally, these were places where people who couldn't afford to live along the coast had settled," Tedesco says. "But as floods have worsened everywhere else, they've come to be seen as prime real estate."

Tedesco has worked with community leaders in Miami, New York City, and several other cities to explore how they could use SEPHER to advocate for policies that would protect people against displacement. He's even created a special version of the tool for New York, which he hopes city officials will use to identify neighborhoods where affordable-housing investments and other initiatives are needed to stabilize at-risk residential communities. "There also has to be close monitoring of evictions, to make sure renters aren't getting kicked out of their homes improperly," he says.

Not all owners of waterfront properties are affluent would-be gentrifiers, though. In fact, in many US coastal towns and cities, working-class districts occupy long stretches of shoreline. Malgosia Madajewicz, an economist at the Columbia Climate School's Center for Climate Systems Research, is determined to make sure that people in these neighborhoods are informed about climate risks. An expert on how people perceive information about climate change and incorporate it into their decision-making, Madajewicz has spent much of her career helping farmers in low-income countries tailor their agricultural strategies to new climate conditions. But after watching Hurricane Sandy devastate coastal communities in New York and New Jersey in 2012 — and seeing many affected homeowners stubbornly rebuild despite climatologists' warnings of worse catastrophes to come — she began conducting research stateside as well. She wondered: how exactly do US coastal residents perceive their own climate risks? Do they have access to the information they need to make good long-term decisions? If not, what's the best way to get it to them?



Neighborhoods surrounding New York City's Jamaica Bay now routinely flood during full and new moons, when tides rise higher than usual. (Nathan Kensinger)

Madajewicz has been conducting studies in oceanfront communities along the Atlantic Coast, from Long Island to Virginia, ever since. Among her insights: most coastal residents badly underestimate the property damage they will experience as a result of rising sea levels. "Ten or fifteen years from now, the pace of sea rise is going to accelerate, which isn't widely understood," she says. By mid-century, she explains, many homes that have rarely if ever flooded in the past are going to be inundated regularly, possibly every year. "It won't take huge storms like Sandy to do it. Much smaller storms will be enough."

Few coastal residents appreciate the risks they face, Madajewicz says, because detailed information on the topic is not readily available. Government-issued flood maps show how high floodwaters have risen in the past but not how climate change will turbocharge future disasters. And public-outreach campaigns aimed at educating homeowners about climate threats rarely include the type of practical information that is likely to alter people's behaviors, like estimates of the long-term financial cost of living in a hazard zone, she says.

To fill the gaps, Madajewicz and several Columbia colleagues are developing new types of outreach materials with clear, practical, and science-based guidance for homeowners in flood plains. To make sure the materials resonate, the researchers are creating them in partnership with representatives of those communities. "We're focused on helping coastal communities with large numbers of low-income and middle-income homeowners, because they often have the least access to scientific information," Madajewicz says.

An ongoing project that her team is leading on the socioeconomically diverse Rockaway Peninsula, along the southern edge of Queens, illustrates the power of their approach. Homeowners in the area, who are among the most vulnerable in New York City to storm surges and flooding, have long viewed their exposure to the elements with a mixture of angst and resignation. They're accustomed to floods coming every few years and with them tens of thousands of dollars in repair costs, even with flood insurance, and they know that this is expected to happen more frequently in the future. But they have only a sketchy idea of how rising sea levels will change their lives and how to prepare. They don't want to leave the neighborhood, where many of them have deep family roots, and few can afford to elevate their homes' foundations for \$150,000 or more. So they do nothing. They wait and see. "This is a problem, because there's a big gap between their perceptions of the risks they face and the risks themselves," Madajewicz says.

"There's a real lack of urgency."

The Columbia researchers recently informed Rockaway residents about their financial vulnerability for the first time. Such information didn't exist before; Madajewicz and her colleagues created it by combining past flood-recovery data from the neighborhood with the latest climate and flood models. They determined that over the next thirty years a typical Rockaway family living in a low-lying two-story house that is worth about \$500,000 can expect to be flooded out of their home twelve to fifteen times and incur nearly \$2 million in damage. "People's jaws just dropped. They couldn't believe that was even possible," says Madajewicz, whose team distributed the information online. The researchers also detailed a wide range of flood-proofing options appropriate for homes on the Rockaway Peninsula, including a lesser-known method of filling one's basement with sand and moving equipment like boilers, hot-water heaters, and circuit boxes upstairs. "That's cheaper than elevating the house and dramatically reduces the recovery costs," says Madajewicz.

One thing that climate scientists know for sure is that America's natural environment will be utterly transformed by mid-century.

And the researchers nudged residents to take a hard look at their future on the peninsula. Before investing large sums of money in flood-proofing one's home, they write in the guidebook, residents ought to ask themselves: do I foresee living in Rockaway decades from now? The Columbia researchers noted that the Corps's eagerly anticipated flood-protection project may feature a storm-surge gate at the mouth of Jamaica Bay that will only be closed during major hurricanes, thus providing Rockaway residents little if any protection against the types of routine storms that pose the greatest threat to their finances over the long run. Of course, it is possible, the researchers write, that government agencies will ultimately fund the construction of additional flood barriers that will ensure Rockaway's future as a thriving beach community. But it is also conceivable that no additional public investments will materialize and the peninsula will become a water-logged ghost town. "Your guess is as good as anyone's at this point," they write.

Since Madajewicz and her colleagues began distributing this information in Rockaway in late 2021, they say, study participants have been abuzz with speculation about the neighborhood's future and how they should prepare. Some are considering filling in their basements, gutting their ground floors, or

implementing other more affordable flood-proofing tricks. "Others are talking for the first time about possibly relocating," says Madajewicz.

The Columbia researchers are now planning a follow-up study to see if their initiative is influencing people's decisions. But they say that simply sparking conversations among residents is progress. In the past, people in Rockaway reported not thinking much about rising sea levels — ironically, because they regarded the problem as too big and overwhelming to wrap their heads around. "When we would ask people how they were preparing, they'd say, 'There's nothing we can do. The government will need to solve this,'" says Madajewicz. "They felt powerless." Now, by contrast, "people are becoming more engaged and motivated to take responsibility for their futures."

Madajewicz says that millions more Americans living on coastlines, in the path of wildfires, and in other threatened areas will soon need to find the same resolve. And she hopes that her research team, by developing communication strategies that could be adopted by other educators and activists for use in their own communities, will ultimately benefit people across the country. "People in the Rockaways are on the front lines of climate change in the US," she says. "They're confronting questions that many others will soon face, if they aren't facing them already: Is my home safe? Will the government help me? Should I move? There are no easy answers. But if scientific information is made available to people in ways that resonate with the real-world decisions they're making, they'll be able to navigate the uncertainties. And everybody deserves to acquire the knowledge they need to protect themselves and their families."

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