

CLIMATE CHANGE fantasy

Using the Pacific nation of Kiribati as a poster child for the ravages of rising seas is not only misleading, it may also be harmful *By Simon D. Donner*

TARAWA ATOLL'S
narrow, lush islands provide
homes and jobs for half
of Kiribati's citizens.

island

An aerial photograph of a tropical island chain. The islands are lush with green vegetation and have sandy beaches. The water is a vibrant turquoise color, transitioning to a deeper blue further out. The sky is filled with soft, white clouds, and the overall scene is bright and scenic.

IN BRIEF

Countries and international aid organizations are hurriedly building seawalls and taking other steps to try to save impoverished island nations from sea-level rise. **Some islands** are not flooding and could even be ri-

sing, as the result of natural ecological processes. **The rush** to do good, a lack of local science and expertise, and a reluctance by native people to say no to outsiders have resulted in bad adaptation projects.

Deeper scientific and cultural understanding is needed to devise the best solution for island nations battling climate change, including ways to relocate people with dignity.

With only three days left in a long research trip, I finally witnessed what I had traveled halfway around the world to document. I saw sea-level rise.

A northwest gale blew across the typically calm lagoon of the Tarawa atoll, the capital of the Pacific island nation of Kiribati, now an icon of the places most likely to drown as climate changes and sea levels rise. By high tide that afternoon, waves were breaching seawalls, flooding roads and swamping homes along the crowded islands of South Tarawa.

Like all the other foreigners who arrive at Bonriki International Airport, still clenching their teeth from landing on a runway that extends from coast to coast, I expected that the impacts of climate change would be easy to detect in a remote, developing country that lacks the money and know-how to adapt. The high water appeared to confirm my hypothesis. That month, for the first time ever, the tide gauge read more than three meters above the baseline. The future had come.

That was 2005.

This year marks the 10th anniversary of the first of what have become my regular trips to Kiribati to research how the islands and their people may or may not be adapting to changes in the atmosphere and ocean. In that time the country has gone from a place not listed in my travel agent's database to international fame. Yet the tide gauge has not reached three meters again.

Make no mistake, Kiribati and other island countries such as Tuvalu, the Marshall Islands and the Maldives are threatened by sea-level rise. Global sentiment to "save Kiribati" and funds to that end have soared. Yet I have been on the ground there, and I see that some of the international response to Kiribati's situation has been ill conceived and could do more harm than good.

I can say that because I have worked with the Kiribati people, heard their stories, learned their customs, been blessed by their ancestors, strained to stay cross-legged on a mat during community meetings, consumed all manner of local marine food, channeled the Professor from *Gilligan's Island* to repair scuba equipment without any tools and been nursed to health after dengue fever. These experiences and my analyses of climate patterns and sea levels there have taught me more about the real-world challenges than one can learn from afar. And

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INGENIOUS RESIDENTS can adapt to a changing ocean in many ways. A woman and son maintain their own seawall (*top*); a man enjoys his raised house (*bottom*).

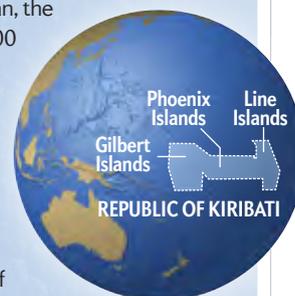
right now it is clear that no one needs to immediately wall in the islands or evacuate all the inhabitants.

What the people of Kiribati and other low-lying countries need instead are well-thought-out, customized adaptation plans and consistent international aid—not a breathless rush for a quick fix that makes the rest of the world feel good but obliges the island residents to play the part of helpless victim.

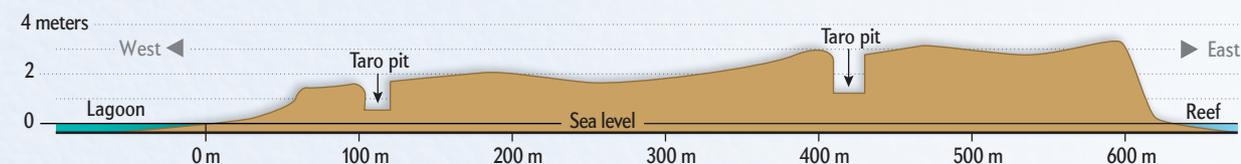
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Flat and Far Between

The Republic of Kiribati comprises three island groups: Gilbert, Phoenix and Line. They contain 33 isolated islands and atolls (a ring of related islands around a lagoon), 21 of which are inhabited. The total landmass of 811 square kilometers, roughly the area of New York City's land, is spread over 3.5 million square kilometers of ocean, the size of India. About half of the 103,000 residents live on the Tarawa atoll (left). Most atoll islands are only a few hundred meters across and have a similar profile (below): a gentle slope of sandy land rises from the lagoon side, leading to a drop to a reef side. The "drop" is relative; the highest point on most of the islands is less than four meters. The most abrupt features are usually pits dug by residents to grow taro for food.



Profile of Buota Island



POSTER CHILD

KIRIBATI (PRONOUNCED "KEE-RE-BAS") certainly looks like the poster child for sea-level rise. The country is not simply in the middle of the Pacific Ocean; it *is* the middle of the Pacific Ocean. It is the only country that crosses the equator, the international date line and, to the bewildered first-time visitor, the *Twilight Zone*.

If the islands of Kiribati were mashed together, they would cover only about two thirds of New York City, but they are spread across ocean the size of India. Two thirds of the land in the Gilbert Islands, the main home of the 103,000 Kiribati people, is less than two meters above mean sea level. Much of that land is so narrow that you can stand on the shore of a placid lagoon and hear the waves breaking on the seaward shore behind you.

A high birth rate and the search for jobs have concentrated half of the population on South Tarawa, a string of islands in the Gilbert group that are crammed with homes, government buildings, World War II wreckage, construction debris, garbage dumps, and not nearly enough intact water pipes or toilets. The world's fastest human, Usain Bolt, could sprint the width of most of South Tarawa in less than 20 seconds, although he would likely fall in a taro pit or pigsty, get hit by several speeding, doorless 1990s Japanese minivans that serve as buses, or trip over someone doing his or her business below the high tide line so that it washes out to sea.

It is no wonder that when the World Bank "spun the globe" to choose the most "vulnerable" country for a climate change adaptation demonstration project, the development agency set-

tled on Kiribati. Today the country's Office of the President receives up to five media requests a week from *i-Matang* (foreigners) seeking to tell the story of a country battling sea-level rise, according to communications officer Rimon Rimon.

The islands of Kiribati, however, are not simply yielding to the sea. Predicting the future of coral reef islands is like balancing a bank account. You cannot look only at the withdrawals—the loss of land through inundation and erosion. You also need to look at the deposits. In some areas, the land is expanding. What is more, some of the flooding that occurs there cannot be blamed on sea-level rise, at least not yet.

SHIFTING SANDS

CORAL ATOLLS ARE LIVING ISLANDS; they can grow. These ring-shaped chains of narrow reef islands are among the youngest landforms on the planet. There are giant sequoias on the coast of California older than most of the islands in Kiribati.

Our understanding of coral atolls can be traced back to a remarkable insight by an obsessive 19th-century pigeon breeder named Charles Darwin. Yes, that Darwin. While voyaging on the *Beagle*, Darwin deduced that atolls were the product of sun-loving coral reefs growing on the slopes of sinking volcanoes. The smoking gun for Darwin's theory came more than a century later, in the form of a hydrogen bomb. American scientists drilling into the Eniwetok atoll in the Marshall Islands in advance of 1950s bomb tests uncovered a volcanic foundation thousands of meters below the limestone reef framework.

The reef framework underlying today's atolls was built long ago. During the low sea levels of the last Ice Age, these frameworks formed rocky islands tens of meters high. As the ice melted, rising seas flooded the islands. New corals chased the rising sea by building up the reef rock under them. Segments of the new reefs eventually breached the surface, killing some of the corals. Although these emergent bits of reef were biologically dead, they were geologically alive: they trapped sand and other material that eroded off the surrounding underwater reefs. Beaches expanded. Winds delivered seeds. Plants grew. And over time, atoll islands—collections of gravel and sediment perched atop a long-dead coral reef—were born.

Until recently, scientists assumed that the accretion of land happened after the most recent Ice Age melt ended and sea level began a slow decline. In the past 20 years, however, geologists such as Paul S. Kench of the University of Auckland in New Zealand

have found evidence that some atolls grew above the surface while sea level was still rising. As Conrad Neumann of the University of North Carolina at Chapel Hill and Ian MacIntyre of the Smithsonian Institution once pointed out, reef islands do not always “give up” to sea-level rise but may be able to “keep up” or “catch up.” It depends on the balance of the rate of sea-level rise and the rate at which the islands collect material.

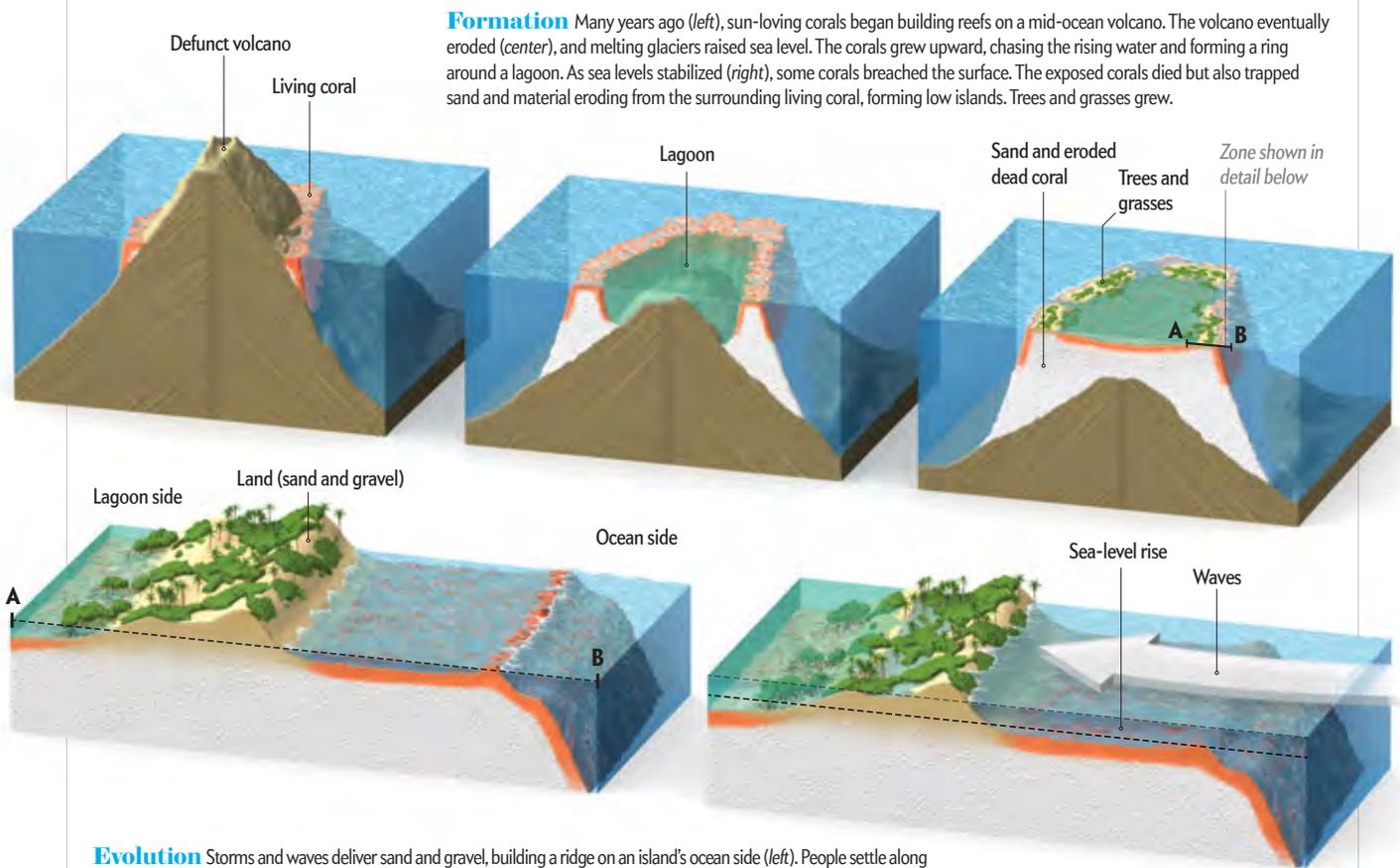
This is where the future gets complicated for Kiribati. Thanks to differences in ocean currents, the extent of surrounding reefs, the angles of various shorelines and the construction of even just a simple pier, one island in an atoll can be eroding while a neighboring island, or even the opposite shore of the same island, is growing. The processes vary from year to year, with the natural ups and downs of the ocean. Some islands in Kiribati are dwindling, but others may be growing.

The potential for islands to grow is not the only circumstance

GEOLOGY

The Rise and Fall of Atolls

The islands in an atoll grow and crumble over time and can change significantly in a few centuries. Some islands evolve in surprising ways as sea level rises. Local ocean currents can build one island while eroding a neighboring island by supplying or stealing sediment. Erecting a simple structure such as a pier or jetty can unwittingly alter the balance.



Formation Many years ago (*left*), sun-loving corals began building reefs on a mid-ocean volcano. The volcano eventually eroded (*center*), and melting glaciers raised sea level. The corals grew upward, chasing the rising water and forming a ring around a lagoon. As sea levels stabilized (*right*), some corals breached the surface. The exposed corals died but also trapped sand and material eroding from the surrounding living coral, forming low islands. Trees and grasses grew.

Evolution Storms and waves deliver sand and gravel, building a ridge on an island's ocean side (*left*). People settle along the middle, protected by the ridge and close to groundwater. Land on the lagoon side remains flatter. As sea level rises (*right*), waves may erode the ridge, flood the lagoon, make groundwater salty and kill vegetation. If the rise is gradual, accumulating sand and gravel might build land fast enough to keep up. If the rise is quick, flooding can carve up and submerge the land.



1



2

ENCROACHING SEAWATER that infiltrates the sandy ground can kill coconut trees (1), make fresh-water wells salty (2) and harm taro, a staple plant with edible roots and leaves that is grown in pits (3).



3

FALSE STEREOTYPE

THE WORLD HAS THE IMPRESSION that Kiribati is drowning because the true-life situation has not been conveyed accurately. Almost every story about the islands features a photograph or video from the village of Bikenikoura, a marginal strip of sand and coastal mangrove forest that is partially inundated at very high tides. The Kiribati government, flooded with requests to “see” sea-level rise, directs foreign journalists and dignitaries such as United Nations secretary general Ban Ki-moon to Bikenikoura. “It is like our case study,” Rimon says. The visitors watch the tide

creep into the *maneaba*, the community meeting hut, and return home with the story of a country being swallowed by the sea.

Bikenikoura, or the “golden beach,” is not emblematic of the region as a whole, however. When the international church association World Assemblies of God Fellowship looked to create a community for outer islanders moving to South Tarawa in search of work, they had to settle for that bit of land because land is precious in the bustling region. As in many parts of the developing world, overpopulation and economic pressures drive people from safer settlements in outer regions to more vulnerable homes near the population center. The lagoon shoreline of South Tarawa is littered with broken seawalls and flooded swamps, the legacy of failed land-reclamation efforts more than rising seas.

Tebunginako, the other flagship village for sea-level-rise tourists, is a similar case of mistaken identity. The flooding there is the unfortunate consequence of a channel between the lagoon and ocean having been naturally blocked generations ago, most likely by a storm, according to analysis by the South Pacific Applied Geoscience Commission. The old name for the land beside the village is Terawabono, which means “blocked channel.”

Flooding in places such as Bikenikoura and Tebunginako winds up being misattributed to sea-level rise because of our expectations. Popular culture, from old, fictionalized tales of European beachcombers to the kitsch of the local tiki bar, has perpetuated a stereotype of idyllic islands inhabited by unsophisticated thatch villages. Visiting for just one week with the explicit purpose of documenting the impacts of sea-level rise

that suggests there is no need to panic for the region’s safety just yet. Despite how it may seem from media coverage, sea-level rise has not created an around-the-clock flood watch in Kiribati, Tuvalu or any other atoll country. Climate change makes extreme events such as floods more likely, but the local height of the ocean at any given time still depends on the natural tidal variations, the weather and the large-scale dynamics of the ocean.

Nowhere is this variability more evident than Kiribati. It is the only country wholly in the path of El Niño, the mischievous interaction between the Pacific Ocean and the atmosphere that disrupts climate every few years. The shift in equatorial winds and currents that characterize El Niño literally raises the ocean in Kiribati. The difference in average sea level at Tarawa between the height of the 1997 El Niño and the low of its contrarian sister La Niña the next year was 45 centimeters—one and a half feet. That is the equivalent of a hill in the flatland of Kiribati.

The record flooding I witnessed during my 2005 visit was a perfect storm of El Niño, a low-pressure weather system driving water toward Tarawa, and the annual high tide. Sea-level rise was complicit in the crime but just as one member of a big cast. El Niño, the weather and the tides make the contribution of sea-level rise to present-day flooding and erosion in Kiribati difficult to detect.

Sea-level rise remains poised to be the star of future sequels to the 2005 floods. Unfortunately, in the world’s zest to find examples of people and places being affected by climate change, the line between what *looks like* sea-level rise and what *is* sea-level rise gets blurred.

triggers a cross-cultural positive feedback loop that only reinforces the image of vulnerable islands.

A North American or European traveling to Kiribati may as well be stepping through a wormhole into another universe. Combine that naïveté with the reserved nature of the Kiribati people, the custom of deferring to outsiders, the legacy of countless past *i-Matang* asking about climate change and the lack of local scientific capacity to verify claims, and a naturally flooding village becomes a victim. Add in the geopolitics—the legitimate need for a tiny country lacking agency on the world stage to raise awareness of a threat to its existence—and the exaggeration about the impacts of sea-level rise can look intentional, whether it is or not. As my friend Claire Anterea of the Kiribati Climate Action Network says, “This is not a story that you will just journalize in one week or two weeks.”

RISING DEBATE ABOUT SINKING ISLANDS

EXAGGERATION, WHATEVER ITS IMPETUS, inevitably invites backlash, which is bad because it can prevent the nation from getting the right kind of help.

The reaction began in 2010, when a paper in the journal *Global and Planetary Change* by Kench and his fellow coastal geology expert Arthur Webb, then at the Pacific Islands Applied Geoscience Commission, reported that 23 of 27 atoll islands across Kiribati, Tuvalu and the Federated States of Micronesia for which old aerial photographs were available had either increased in area or remained stable over recent decades. Such historical data are not available for most island nations, although similar results have since been reported for atolls in French Polynesia.

These findings tell us that so far prevailing currents, coastal development and other factors have had more influence on the islands' land area than sea-level rise. The paper by Kench and Webb notes, for example, that the undeveloped North Tarawa island of Buariki has grown by 2 percent since 1943, thanks to natural buildup of the lagoon shore. Much greater expansion has occurred in the developed islands, in many cases as an inadvertent result of human action. In one case, years of linking South Tarawa islands by causeways blocked water flow and redirected sand from the lagoon toward crowded islets such as the government center of Bairiki, which has expanded by 16 percent since 1969.

The findings do not tell us whether the islands have increased in height, whether they will continue to expand under higher rates of sea-level rise, or whether they will continue to store enough freshwater for the people and plants. Of course, islands can erode away, too, which is clear to a visitor looking out from the shore of busy Bairiki at the empty lagoon islet of Bikeman. Robbed of sediment by the same causeway construction that expanded Bairiki, Bikeman went from a green splotch on British colonial maps to a divided sandbar, barely visible at high tide.

Unfortunately, the politicized public discourse on climate change is less nuanced than the science of reef islands. After the Webb and Kench paper was published, headlines mocked previous claims that Kiribati and the other atoll countries are threatened by sea-level rise. The present-day impacts of sea-level rise have since become a political football, with President Anote Tong and some activists claiming the end is nigh, and doubters inside and outside of Kiribati questioning whether the president, along with other politicians or the country as a whole, is merely using talk of sea-level rise for international attention and financial gain.

RUSHING THE WALL

THE GOOD NEWS ABOUT the dynamism of reef islands is that it can buy time for places like Kiribati. That may mean decades or more that can be devoted to adaptation, not evacuation.

The bad news is that the dire talk about rapidly drowning islands makes the already tough task of adaptation even tougher. Once a place is cast as a poster child for climate change, it must continue performing the role for the world, observes my colleague Sophie Webber, a graduate student in geography at the University of British Columbia. Play a role for too long, and you risk becoming the character.

Kiribati is genuinely at risk. Overemphasizing this vulnerability, however, can undermine the resilience of the islands and its people. For example, the drought-prone southern Gilbert Islands are famous in Kiribati for a strong work ethic and community spirit. Yet when the well water in a community on one of those islands, Beru, turned salty a couple of years ago, the community threw up its hands and blamed climate change.

The residents did not suspect, or inspect, the new solar-powered water pumps that had been provided by an aid agency to replace the old fuel-powered pumps and increase resilience to drought. A local consultant later found that the new pumps, not limited by fuel, had been running nonstop and draining the groundwater. The problem was corrected, but the incident highlights the downside of well-meaning foreigners swooping in to rescue people. Rhetoric about a global threat can cause even the most self-sufficient people to blame the world for their problems and question their ability to take action.

The focus on vulnerability also draws the international media, and even the Kiribati government, toward click-worthy side-shows that generate publicity rather than concrete improvements on the ground. One Kiribati man requested refugee status in New Zealand because he claimed climate change threatened his home; in reality, he overstayed his New Zealand visa and did not want to leave. The Kiribati government's recent land purchase in Fiji has been widely reported to be a place for relocating islanders in need of imminent evacuations; in actuality, the deal was a controversial use of limited government funds to secure a former coconut plantation for food supply and other purposes, criticized by opponents of President Tong as a publicity stunt.

The reality is that the next few decades for low-lying reef islands will be defined by an unsexy, expensive slog to adapt. Success will not come from single land purchases or limited-term aid projects. It will come from years of trial and error and a long-term investment by the international community in implementing solutions tailored to specific locales.

One such program, the Kiribati Adaptation Program, funded by the World Bank and others to demonstrate how to do climate change adaptation, has revealed how difficult the task is. It took eight long years of consultation, training, policy development and identifying priorities for the project to finally create something concrete in 2011: seawalls at several places, including the tip of an airport runway, a prominent community and parts of two causeways. Project leaders and the international contractors, under pressure from donors, the Kiribati government and the public to take visible action, settled on a simple design that could be replicated by the local government in the future. But the compromise design lacked expensive measures to reduce wave energy and erosion that are recommended by coastal experts.



SOLID CAUSEWAY built several decades ago to link the islets of Betio and Bairiki blocked the flow of water and sediment, inadvertently changing the shape of nearby islands.

Within a few months, the ends of the seawalls were damaged by waves and adjacent beach erosion, in one case dangerously exposing the pipe that carries South Tarawa's freshwater. Fingers were pointed at the contractors for the design, the World Bank and international donors for inflexible procedures and expectations that influenced the decisions, and the project leaders and Kiribati government for not better appreciating the potential adverse effects of seawalls.

The failure could still be turned into a success. Workers for the project are now rehabilitating the seawalls, using a more sloped design and vegetation to absorb some of the incoming wave energy, and project leaders are establishing a new protocol for adaptation projects of the future. Responding to climate change in a place like Kiribati requires a sustained commitment to building local scientific and engineering capacity and learning from mistakes.

A FUTURE WITH DIGNITY

THE FACT THAT REEF ISLANDS can grow in some cases and that adaptation measures can help will not save Kiribati forever, especially if the world fails to reduce greenhouse gas emissions. Climate models project that if we stay on the current emissions path, sea level could be rising at the end of the century at more than five times today's rate. Even in the unlikely case that islands are able to continue, on net, to accumulate material at their current rate, they may become narrower, steeper and possess less freshwater, making them prohibitively expensive to inhabit.

Growing with sea level would also be a mixed blessing for developed islands, whether Tarawa or Male, the crowded capital of the Maldives. In the old days, when homes were made of thatch and wore down roughly every seven years, moving with the islands might have been realistic. But today potential growth from sand and gravel accumulating on the sides or tops of islands occurs where there are homes, roads, hospitals and ports. The infrastructure might inhibit natural island evolution, or the evolution might necessitate expensive or untenable relocation of

the infrastructure. And expecting all of the people to move to less populated, less developed outer islands, such as the larger and drier island of Kirimatangi thousands of kilometers east of Tarawa, would be nonsensical. Efforts to relocate people would have to counter a force that is possibly even greater than that of climate change: the human development of infrastructure.

Instead Kiribati has launched an initiative that sets an example for other island nations worried about their future. The "Migration with Dignity" initiative is looking to countries such as Australia that have aging populations and would offer Kiribati youth a place that needs their labor. That way, if Kiribati's day of reckoning does come, migrants could join an existing expatriate community rather than be treated as refugees.

The initiative is a reminder that to cope with climate change, the Kiribati people need more than just money and attention. They need respect. That means not using Kiribati as a narrative device in a debate about climate change ("We need to reduce emissions to save these drowning islanders") or as a showcase to prove an institution is helping people deal with climate change. However well intentioned, quickly reported stories and limited-term aid projects lead to time and resources being wasted on futile ideas and duplicated efforts rather than on developing the skills, long-term management strategies and lasting relationships needed to prepare for an uncertain future. In 2005 I traveled to Kiribati thinking three weeks would be long enough to understand how climate change was affecting the country. Ten years later I am still trying to fully wrap my arms around that question.

As you travel out to sea in Kiribati, the flat islands quickly disappear below the horizon. In the old times, fishers navigated home by looking for the reflection of the shallow, greenish lagoon waters in the clouds. One day in the distant future, many of the islands of Kiribati could succumb to the sea. The people may leave, the trees may die and the land may become a submerged reef. The lagoons, still shallow in contrast to the deep open ocean, would remain green as before.

To outsiders, Kiribati would be gone. To the Kiribati people, the ghost of their former homeland would live on in the clouds. ■

MORE TO EXPLORE

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Sea Level Rise and the Ongoing Battle of Tarawa. Simon Donner in *EOS, Transactions of the American Geophysical Union*, Vol. 93, No. 17, pages 169-170; April 20, 2012.

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Developments in Coral Reef and Reef Island Geomorphology. Paul S. Kench in *Geomorphology*, Vol. 222, pages 1-2; October 1, 2014.

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