EarthBeat
Science

Warm water expands, raising sea levels, which worsens storm surge during hurricanes. It’s only one risk from warming oceans. AP/Gerald Herbert

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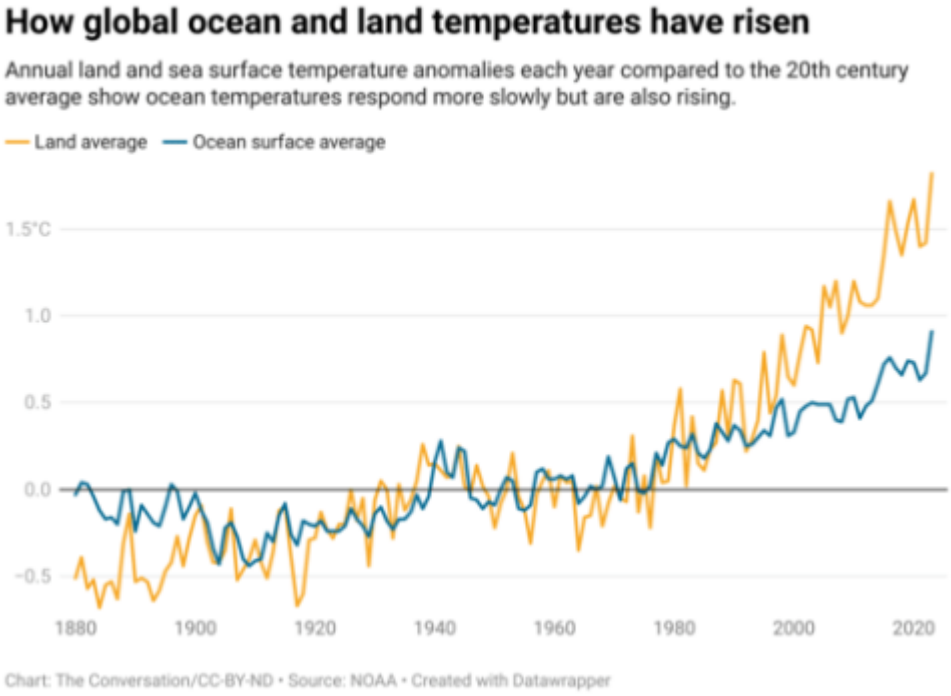
Ocean-related tourism and recreation supports more than 320,000 jobs and US $13.5 billion in goods and services in Florida. But a swim in the ocean became much less attractive in the summer of 2023, when the water temperatures off Miami reached as high as 101 degrees Fahrenheit (37.8 Celsius).

The future of some jobs and businesses across the ocean economy have also become less secure as the ocean warms and damage from storms, sea-level rise and marine heat waves increases.



Ocean temperatures have been heating up over the past century, and hitting record highs for much of the past year, driven primarily by the rise in greenhouse gas emissions from burning fossil fuels. Scientists estimate that more than 90% of the excess heat produced by human activities has been taken up by the ocean.

That warming, hidden for years in data of interest only to oceanographers, is now having profound consequences for coastal economies around the world.

Understanding the role of the ocean in the economy is something I have been working on for more than 40 years, currently at the Center for the Blue Economy of the Middlebury Institute of International Studies. Mostly, I study the positive contributions of the ocean, but this has begun to change, sometimes dramatically.

Climate change has made the ocean a threat to the economy in multiple ways.

The dangers of sea-level rise

One of the big threats to economies from ocean warming is sea-level rise. As water warms, it expands. Along with meltwater from glaciers and ice sheets, thermal expansion of the water has increased flooding in low-lying coastal areas and put the future of island nations at risk.

In the U.S., rising sea levels will soon overwhelm Isle de Jean Charles in Louisiana and Tangier Island in Chesapeake Bay.

A winter storm that hit at high tide sent water rushing into streets in Portland, Maine, in January 2024. AP/Robert F. Bukaty

Flooding at high tide, even on sunny days, is becoming increasingly common in places such as Miami Beach; Annapolis, Maryland; Norfolk, Virginia; and San Francisco. High-tide flooding has more than doubled since 2000 and is on track to

triple by 2050 along the country's coasts.

Rising sea levels also push salt water into freshwater aquifers, from which water is drawn to support agriculture. The strawberry crop in coastal California is already being affected.

These effects are still small and highly localized. Much larger effects come with storms enhanced by sea level.

Higher sea level can worsen storm damage

Warmer ocean water fuels tropical storms. It's one reason forecasters are warning of a busy 2024 hurricane season.

Tropical storms pick up moisture over warm water and transfer it to cooler areas. The warmer the water, the faster the storm can form, the quicker it can intensify and the longer it can last, resulting in destructive storms and heavy downpours that can flood cities even far from the coasts.

When these storms now come in on top of already higher sea levels, the waves and storm surge can dramatically increase coastal flooding.

Tropical cyclones caused more than $1.3 trillion in damage in the U.S. from 1980 to 2023, with an average cost of $22.8 billion per storm. Much of that cost has been absorbed by federal taxpayers.

It is not just tropical storms. Maine saw what can happen when a winter storm in January 2024 generated tides 5 feet above normal that filled coastal streets with seawater.

What does that mean for the economy?

The possible future economic damages from sea-level rise are not known because the pace and extent of rising sea levels are unknown.

One estimate puts the costs from sea-level rise and storm surge alone at over $990 billion this century, with adaptation measures able to reduce this by only $100 billion. These estimates include direct property damage and damage to

infrastructure such as transportation, water systems and ports. Not included are impacts on agriculture from saltwater intrusion into aquifers that support agriculture .

Marine heat waves leave fisheries in trouble

Rising ocean temperatures are also affecting marine life through extreme events, known as marine heat waves, and more gradual long-term shifts in temperature.

In spring 2024, one third of the global ocean was experiencing heat waves. Corals are struggling through their fourth global bleaching event on record as warm ocean temperatures cause them to expel the algae that live in their shells and give the corals color and provide food. While corals sometimes recover from bleaching, about half of the world's coral reefs have died since 1950, and their future beyond the middle of this century is bleak.

Losing coral reefs is about more than their beauty. Coral reefs serve as nurseries and feeding grounds for thousands of species of fish. By NOAA's estimate, about half of all federally managed fisheries, including snapper and grouper, rely on reefs at some point in their life cycle.

Warmer waters cause fish to migrate to cooler areas. This is particularly notable with species that like cold water, such as lobsters, which have been steadily migrating north to flee warming seas. Once-robust lobstering in southern New England has declined significantly.

In the Gulf of Alaska, rising temperatures almost wiped out the snow crabs, and a $270 million fishery had to be completely closed for two years. A major heat wave off the Pacific coast extended over several years in the 2010s and disrupted fishing from Alaska to Oregon.

This won't turn around soon

The accumulated ocean heat and greenhouse gases in the atmosphere will continue to affect ocean temperatures for centuries, even if countries cut their greenhouse

gas emissions to net zero by 2050 as hoped. So, while ocean temperatures fluctuate year to year, the overall trend is likely to continue upward for at least a century.

There is no cold-water tap that we can simply turn on to quickly return ocean temperatures to “normal,” so communities will have to adapt while the entire planet works to slow greenhouse gas emissions to protect ocean economies for the future.