Travel
The Global Climate-Change Island Guide — Which islands are safest from nature's dark side? We crunched the numbers on 40 destinations
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The Dominican Republic is the second-most-visited spot in the Caribbean, with 800 miles of coastline, sparkling white-sand beaches, and a rare species of talkative parrot. There is, however, the small problem of hurricanes: The nation has taken direct hits from at least five in the last 10 years. It also happens to be on the only island in the Caribbean with a malaria problem. In recent years, some of its famed pink and orange coral has turned gray, and schools of tropical fish are thinning out.

"It was kind of like going to see a desert underwater," says Stewart Penn, a Larchmont, N.Y., book wholesaler and diving aficionado who took a family trip to the island last Christmas. This year, the Penns are headed to Costa Rica instead.

Surrounded by water and composed mainly of low-lying areas, islands are particularly subject to nature's vicissitudes, including global climate change. While the causes and implications of climate change are hugely divisive issues, few dispute that the world on average has been getting warmer -- the 10 warmest years on record have all occurred since 1990. This year is so far the second-warmest globally since accurate thermometer readings began around 1880, according to the U.S. government's National Oceanic and Atmospheric Administration.

This gradual warming is affecting tourist destinations around the world in ways that are subtle and not so subtle. For colder locations, some researchers suggest warming could eventually boost tourism. Elsewhere, the climate shift is helping spur everything from beach erosion to coral bleaching -- even more mosquitoes at higher altitudes.

Though the temperature rise -- an average of roughly one degree Fahrenheit globally over the past century -- seems small, tiny changes can set off a chain reaction in the environment. Warmer temperatures melt glaciers and cause water to expand, making sea levels rise. Those rising waters can flood low areas and erode sandy beaches and fragile coasts.

Heat in the ocean is also the main energy source for tropical storms, and most climate researchers blame the warmer Atlantic for helping fuel this year's devastating hurricane season. Coral, meanwhile, is sensitive to even slight rises in temperature. Warm water bleaches reefs by killing organisms that live inside the coral, draining reefs of color and making them more susceptible to disease and permanent damage. Since coral reefs shelter coastlines and generate sand, such damage can exacerbate erosion and flooding.

In Grenada, beach erosion from tropical storms and weakened coral reefs has destroyed nesting spots for leatherback turtles -- a big tourist draw -- says Paul Phillip, a marine biologist in the Grenada Department of Fisheries. On the Hawaiian island of Maui, erosion has erased about nine miles of beach -- equivalent to 7% of the shoreline -- in the last century, says Sam Lemmo, a conservation officer in Hawaii's Coastal Lands Program.

St. John in the U.S. Virgin Islands is experiencing the island's worst-known bout of coral bleaching due to record-high water temperatures this summer and fall, says Caroline Rogers, a marine biologist for the U.S. Geological Survey. At Low Key Watersports, one of the island's big dive operators, manager Ellen Winsor says she now plays down the coral on some dives, instead selling customers on the chance to visit a shipwreck, pet a sting ray or spot an eel.

Not all islands are affected equally. For instance, water on the eastern side of ocean basins tends to be cooler, making hurricanes less likely for islands like the Azores and Tahiti. The shape of individual islands plays a role, too. Those with high cliffs can shade offshore areas from sunlight, keeping things cooler and helping protect the coral.

With winter booking season for island getaways hitting full swing, we wanted to find out which islands are most at risk from climate change. Consulting with climatologists and statisticians, we developed an island risk index. We crunched data for 40 islands, from Tuvalu in the Pacific to Sicily in the Mediterranean, factoring in everything from temperature changes to hurricane landfalls.

While hurricane season lasts only a few months, ending in the Caribbean, for example, in November, it can have long-lasting effects on coral reefs and beaches. The index is weighted to take into account that some variables have more impact than others. We also included other natural hazards, including volcanic eruptions and malaria, which has affected tourists on Asian islands as well as the Dominican Republic in recent years. (See "Behind the Index," below.)

The results showed that the risks for tourists can vary quite a bit. Fiji, for instance, may have a romantic South Pacific ring
to it -- but four severe typhoons have made landfall there in the last 20 years, which helped put it near the bottom of our rankings. Fiji's risk level was also slightly increased by the presence of volcanoes; a volcano that has bubbled over within the last 10,000 years can erupt again at any time, says John Ewert, a volcanologist for the U.S. Geological Survey.

But the prospects are better at Cape Verde, a set of islands off the west coast of Africa that drew some 157,000 tourists last year and tied for 11th best in our risk index. You might think that a place that has a type of hurricane named after it isn't a place you want to be in the winter. But while hurricanes tend to begin forming nearby, they head west before causing damage. And, because the islands are volcanically formed, their topography is diverse enough to create a barrier against flooding and tsunamis.

If you really want to minimize your risk, think north -- far north. Clocking in with the lowest risk index was Canada's Prince Edward Island, where one of the most popular attractions is the house that inspired the "Anne of Green Gables" story. Full disclosure: While its white-sand beaches are popular in summer, the average temperature in December is 24 degrees. Martha's Vineyard also fared well in our index, with the second-lowest risk rating and ahead of highly ranked Curacao and the Florida Keys.

Of course, it's easily possible to have a great vacation even in places that scored relatively poorly in our risk index. Hawaii, for example, came in 30th in our list, with its score partly hampered by hurricanes that hit Kauai. And no index can perfectly model -- let alone predict -- weather and other natural risks. Though bad weather is influenced by natural cycles and geography, chance plays a big role as well.

To design the index and decide how to weight factors in it, we consulted several statisticians and scientists, including Michael Mastrandrea, a Stanford University researcher who models risks from climate change. To help compensate for varying methods of gathering weather data around the world, we relied largely on data collected by NOAA, the National Aeronautics and Space Administration, and the U.S. Geological Survey.

Here are snapshots of five islands in our index and how they are affected by -- and dealing with -- recent changes in nature. They're listed in order from least to most risky based on our rankings.

**Bonaire**

Most of the Caribbean has been hit hard by coral bleaching because of warmer water. But Bonaire, 50 miles off the Venezuelan coast, has managed to preserve large swaths of reef. It took early steps to protect its fragile coral, passing laws in the 1970s that banned spearguns. In April, it raised the entrance fee for divers to get into a marine park around the island to $25 from $10 -- some of the proceeds go toward monitoring the reefs. Also, its coral reefs and beaches are largely outside the hurricane belt, which helps to shelter them from the intense waves and tropical storms. This was part of the reason that Bonaire finished sixth in our index.

Christmas kicks off the high season, but some hotels are offering deals in November and December. The Harbour Village Beach Club has a Dive Into Luxury package through Dec. 17 that includes seven nights and six days of diving -- fees for the second diver are waived. Rates for a one-bedroom beachfront suite start at $1,875.

**Crete**

Like all Mediterranean islands, Crete is relatively safe from hurricanes; and there have been no serious natural disasters on the island in at least the last 20 years. (Crete came in eighth in our test.) In part because the Mediterranean occupies a smaller, shallower basin than some oceans, temperatures have risen more dramatically, which can be nice for swimmers.

"It was a perfect temperature," says Wendi Berkowitz, a San Francisco attorney who traveled to Crete with her husband this fall and went for a dip in Elounda Bay.

The island is known for its Greek ruins. In October, archaeologists discovered two life-size marble statues of the Greek goddesses Athena and Hera, dating to between the second and fourth centuries, in the town of Gortyn. The island is also a mecca for foodies. Crete's Culinary Sanctuaries is offering tours of two new organic olive farms on the west side of the island this winter. A six-day package starts at $1,600 and includes meetings with local cooks, tours of ruins, hikes through gorges and accommodations.

**Galapagos**

The Galapagos Islands tied for 11th on our list. They are close to the equator and surrounded by cool water, which keeps tropical storms from forming. But the islands also have a volcano that erupted just last week for the first time since 1979. The biggest threats to the Galapagos come from people rather than nature. The Galapagos National Park Service now restricts immigration from mainland Ecuador because population increases were straining the natural resources.

For years, tourists could see the islands only via a floating tour boat. But in recent years, the burgeoning tourist industry has started building hotels on land, like the Royal Palm Hotel on Santa Cruz. There's also been an upsurge in environmentally focused tourist cruises, from companies like Lindblad Expeditions, which last fall added a new boat that has a floating spa and recently got government permission to offer sea kayaking.

**Bahamas**

The Bahamas are in the heart of the hurricane zone -- one of the islands has been struck by more of them than any other Caribbean island in the last century. That's the main reason why the Bahamas came in 23rd on our list. As big-name hotel developers continue to stream in, locals are beginning to pay more attention to other kinds of natural threats, according to environmentalists. Groups like the Bahamas Reef Environment Educational Foundation organize beach-restoration projects,
and environmental groups persuaded the government to ban grouper fishing for five weeks this winter.

It's one of the most popular travel spots in the Caribbean region, partly because it has so many direct flights from the U.S. A sample package deal: round-trip airfare and three nights' stay at the Vegas-style megaresort Atlantis on Paradise Island, starting at $464 per person (via Orbitz).

Oahu, Hawaii

The state's 24 miles of swimmable beach are eroding fast, according to some scientists. But Oahu has some of the best-preserved beaches on the state, says Chip Fletcher, a coastal geologist at the University of Hawaii. This winter, the state's Coastal Lands Program will put $450,000 into dumping 10,000 cubic yards of offshore sand back onto Oahu's Waikiki Beach, which gets 8.5 million visitors a year.

To get away from the crowds -- Oahu is by far the most popular of Hawaii's big islands -- go to the north-shore beaches, about an hour by car from Honolulu, says Mr. Fletcher. He recommends Kailua Beach, which naturally replenishes its own sand, and Malaekahana, a more rugged beach park. For travelers looking to island-hop, two new airlines, including FlyHawaii, will begin service next year.

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BEHIND THE INDEX

The Dow Jones Island Index includes 12 factors that reflect a range of environmental risks that islands and island tourists face. For the most part, we were able to get entire data sets from a single source. After weighting the metrics based on the relative risk to travelers, we combined the raw scores, and then scaled them, with the highest value set to 100. The metrics, with sources in parentheses: Number of hurricanes making landfall in the last 20 years (National Oceanic & Atmospheric Administration); number of natural disasters, excluding tropical storms and infectious diseases, since 1985 (EM-DAT, Universite Catholique de Louvain); Environmental Vulnerability Index subindices by country for climate change and for natural disasters (South Pacific Applied Geoscience Commission); presence of active volcanoes (Smithsonian Global Volcanism Program); change in average annual land temperature 1975-2004 (Goddard Institute for Space Studies); change in average annual ocean temperature 1975-2004 (Goddard Institute); UV indexes for January and July (NASA); average wind speed over five years (NOAA); presence of malaria (World Health Organization); number of shark attacks in 2004 (International Shark Attack File at the Florida Museum of Natural History).

(See accompanying illustration -- WSJ Oct. 29, 2005)

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