

# Harness a hurricane and the world will be yours

By JOY ASCHENBACH  
National Geographic News Service

Wet, windy and unpredictable, hurricanes run by themselves, like huge self-sustaining heat engines spinning across the sea.

Extracting heat energy from the warm ocean, hurricanes release it into the atmosphere. If converted to electrical energy, the energy released by a single hurricane in one day would keep the U.S. supplied with power for three years.

As big as 500 miles or more in diameter and reaching almost eight miles high, hurricanes are the greatest storms on earth. Their name comes from the Spanish and Caribbean Indian words for big wind and evil spirit.

Hurricanes can produce cyclonic winds of 200 mph or more — the most violent around the relatively calm eye of the storm. They can cause coastal waters to swell as high as 25 feet above normal tide. They can travel long distances — several thousand miles across water at speeds of up to 50 mph. And they have a long life expectancy by atmospheric standards: one to two weeks.

IN THE ATLANTIC, Caribbean, and Gulf of Mexico, hurricanes in this century have killed an estimated 45,000 people, including more than 13,000 in the U.S. Nine out of 10 hurricane victims drown in water that is swept ashore with the high winds. Six thousand people died in Galveston, Tex., in September 1900 in a storm that leveled that city. It is regarded as the worst U.S. hurricane disaster.

Rivalled in size only by their western Pacific and Indian Ocean counterparts

— typhoons and cyclones — hurricanes have caused more than \$12 billion damage in the U.S. alone since 1900. The costliest was last season's \$2.3 billion Hurricane Frederic.

All of this destructive force is concentrated in an average of six hurricanes in a six-month season, June through November. Less than one-tenth of the some 100 tropical disturbances that could become hurricanes actually do, the worst usually occurring in August and September. On the average, two or three hurricanes strike the North American mainland each season.

At their fiercest — a catastrophic No. 5 on the Saffir-Simpson classification scale — their wind speed exceeds 155 mph and the atmospheric pressure in the eye drops drastically. A half-dozen hurricanes in this century have rated a 5, among them: the 1935 Labor Day storm that ripped through the Florida Keys, the strongest on record; this season's Allen, which swept across the Caribbean into Texas, the second strongest; and Camille in 1969, which devastated the Mississippi and Louisiana coasts.

ALTHOUGH THEY have stalked the Atlantic region almost every year since at least Columbus' time, hurricanes still baffled scientists. They create their own complicated environment that depends on the right blend of several key ingredients: proper water temperature, warm moist air, and a good circulation system that lets air flow in at the bottom and up and out at the top — like smoke up a chimney.

Hurricanes begin calmly enough. Most start as the summer sun warms the tropical waters around the Cape Verde Islands west of Africa to at least

80 F. Waves of moist air drift off the African coast. Trade winds blowing west as sustained by the stable Bermuda high, a mass of warm humid air that straddles the North Atlantic and controls its weather in summer and fall. Patches of concentrated showers ride the trade winds.

Moving across the warm ocean, these diverse forces mysteriously begin to organize themselves and steadily intensify. Showers mature into thunderstorms. Air whirls around low-pressure troughs.

WHEN SUSTAINED winds reach 39 mph, the disturbance is upgraded to a tropical storm and given a name — as of last year male or female. When wind velocity accelerates to at least 74 mph, the tropical storm officially becomes a hurricane.

"We still don't know exactly what triggers a hurricane — why, given apparently favorable conditions, one storm develops and another doesn't," said meteorologist Mark Zimmer of the National Hurricane Center in Miami, which monitors all of the disturbances that form each season.

"Our weakest point — and the reason that hurricanes are almost impossible to predict — is our inability to tell whether or not a storm will intensify —

and when. Once it does, we have a reasonably good grip on tracking direction and speed."

What scientists know about what goes on inside a hurricane most closely resembles the operation of a heat engine or a fire in a fireplace. At the sea surface, air heated by the warm ocean rises, cools, condenses, and forms bands of thick clouds that release torrential rains.

As the air rises and cools, it gives off heat, greatly reducing the atmospheric pressure at the center. At lower altitudes, when the pressure drops, the trade winds are propelled in a spiral pattern by the spin of the earth. In the northern hemisphere they swirl in a counterclockwise or cyclonic direction.

AIR WHIPS inward around the calm eye and is whirled upward. When it rises to about 40,000 feet, it vents the system, merging with high altitude winds. Now dry, some air is forced back down the center, creating the virtually cloud-free eye, usually about 25 miles across.

Wind speed picks up near the eye and is strongest in the eyewall, the innermost band of clouds that is usually about 15 miles thick. It is here — across this central 50 to 75 miles —

that the storm does its greatest damage.

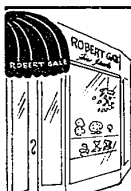
The hurricane eye — a frequent metaphor for order in the midst of chaos — apparently controls a storm's wind velocity. The smaller its diameter and the lower its pressure, the stronger the winds. Atmospheric pressure in Allen's center plunged to the second lowest level on record, 10 percent below normal atmospheric pressure and double the drop in the average hurricane.

Low pressure in the eye is also the dominant force behind the storm surge that kills most hurricane victims. Beneath it the ocean surface rises, forming a dome of water one or two feet high.

As the hurricane heads for land, wind drives more water onto the dome. This combination can produce waves 25 feet above normal tide if it hits a sloping shoreline.

As it strikes land, a hurricane does its worst damage. Once over land — cut off from its ocean power source — it quickly runs out of steam. Fueled by the ocean's warmth, it is also doomed if it travels over cooler northern waters.

For all their destructive elements, hurricanes do have their good points. They bring much-needed rain to tropical islands and take away some of the tremendous heat that builds up near the equator.



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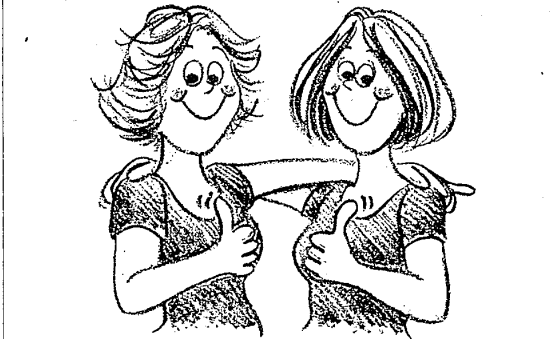
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