

# What Are Hurricanes?

This text is from the "NASA Knows!" series from NASA.



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*NASA studies hurricanes to learn how they form and to better predict where they will go.*

Hurricanes are large, swirling storms with winds of 119 kilometers per hour (74 mph) or higher. That's faster than a cheetah, the fastest animal on land.

The storms form over warm ocean waters and sometimes strike land. When a hurricane reaches land, it pushes a wall of ocean water ashore. This wall of water is called a storm surge, which along with heavy rain can cause flooding, especially near the coast.

Once a hurricane forms, weather forecasters predict its path and how strong it will get. This information helps people prepare for the storm before it arrives.

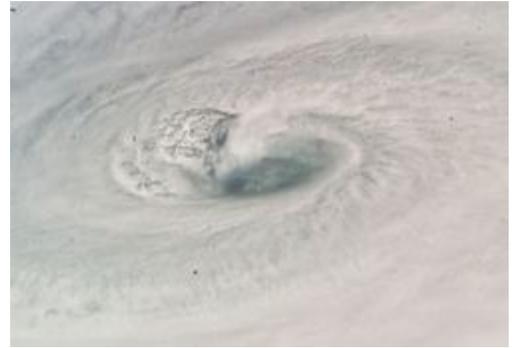
## How Are Hurricanes Categorized?

A hurricane is categorized by its wind speed using the Saffir-Simpson Hurricane Scale.

- **Category 1:** Winds 119-153 km/hr (74-95 mph) - faster than a cheetah
- **Category 2:** Winds 154-177 km/hr (96-110 mph) - as fast or faster than a baseball pitcher's fastball
- **Category 3:** Winds 178-208 km/hr (111-129 mph) - similar, or close, to the serving speed of many professional tennis players
- **Category 4:** Winds 209-251 km/hr (130-156 mph) - faster than the world's fastest rollercoaster
- **Category 5:** Winds more than 252 km/hr (157 mph) - similar, or close, to the speed of some high-speed trains

## What Are the Parts of a Hurricane?

- **Eye:** The eye is the "hole" at the center of the storm. Winds are light and skies are only partly cloudy, sometimes even clear, in this area.
- **Eye wall:** The eye wall is a ring of thunderstorms swirling around the eye. The wall is where winds are strongest and rain is heaviest.
- **Rain bands:** Spiral bands of clouds, rain and thunderstorms extend out from a hurricane's eye wall. These bands stretch for hundreds of miles and sometimes contain tornadoes.

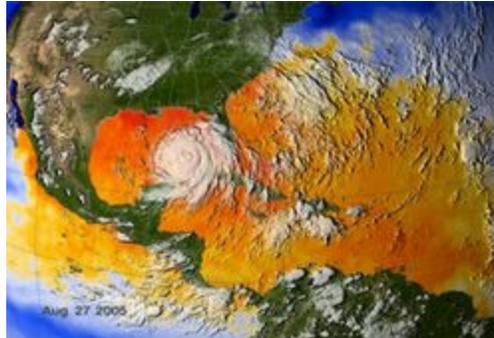


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*The eye of Hurricane Dean is shown as it moved through the Caribbean.*

## How Does a Storm Become a Hurricane?

A hurricane starts out as a tropical disturbance, an area over warm ocean waters where rain clouds are building. A tropical disturbance sometimes grows into a tropical depression, an area of rotating thunderstorms with winds of 62 km/hr (38 mph) or less. A tropical depression becomes a tropical storm if its winds reach 63 km/hr (39 mph). A tropical storm becomes a hurricane if its winds reach 119 km/hr (74 mph).



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*Warm water in the Gulf of Mexico and the Caribbean during the late summer months helps to fuel hurricanes.*

## What Makes Hurricanes Form?

Scientists don't know exactly why or how a hurricane forms. But they do know that two main ingredients are necessary: warm water and winds that don't change



much in speed or direction as they go higher in the atmosphere.

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*In 2010, astronauts on the International Space Station took a picture of Hurricane Earl.*

Warm ocean waters provide the energy needed for a storm to become a hurricane. Usually, the surface water temperature must be 26 degrees Celsius (79 degrees Fahrenheit) or higher for a hurricane to form.

The rate at which wind speed or direction changes with height is called vertical wind shear. Low vertical wind shear - winds that change very little going up through the atmosphere - is needed for hurricane development. High vertical wind shear - winds that are changing significantly with height - tends to rip storms apart.

## How Are Hurricanes Named?

One reason hurricanes are named is because more than one may exist at the same time. Names make it easier to keep track of and talk about storms.

A storm is given a name if it reaches tropical storm strength. That name stays with the storm if it goes on to become a hurricane.

Each year, tropical storms are named in alphabetical order as they occur. The names come from lists of names that are maintained and updated by the World Meteorological Organization.

There are six lists of names. Each year starts with the next list. The same lists are reused every six years. Names of storms that are very deadly or costly are removed from the lists and replaced with new names.

## How Does NASA Study Hurricanes?

NASA satellites take pictures of hurricanes from space. NASA scientists use data from satellites and other sources to learn more about hurricanes. The data helps them understand how hurricanes form and get stronger. The data also helps to improve the models that weather forecasters use to predict the path and strength of hurricanes.

NASA's Aqua satellite measures clouds, rainfall and sea-surface temperatures. NASA's CloudSat satellite also collects information on clouds. NASA's Tropical Rainfall Measuring Mission satellite observes the three-dimensional pattern of rainfall in hurricanes. TRMM also helps forecasters locate a hurricane's eye, especially when it is hidden under clouds. These measurements help show how strong a storm might be.

The SeaWinds instrument on NASA's QuikSCAT satellite measures wind speed and direction. These measurements enable earlier detection of developing hurricanes.

Did you know that dust storms from Africa might affect hurricanes? NASA's Terra and Aqua satellites

have a tool that tracks dust coming off of Africa. The tool MODIS helps scientists study the impact of dust on hurricane formation and strength.

NASA research aircraft fly into and above hurricanes to gather detailed storm data. NASA has also flown an unmanned aircraft into areas of a hurricane that are too dangerous for manned aircraft.

The Convection and Moisture Experiment is one of several NASA field research missions that have studied hurricanes. These missions use a combination of instruments on satellites, on aircraft and on the ground. The missions study the development, track, strength and rainfall of hurricanes.

NASA has also created computer animations of hurricanes using rain, wind and temperature data from multiple satellites. These animations could help forecasters more accurately predict storm damage.

## How Will NASA Study Hurricanes in the Future?

NASA is developing several instruments that will help scientists better understand hurricanes. They will also help scientists improve models used to forecast the storms.

The Hurricane Imaging Radiometer is designed to work from an airplane or satellite. From above, HIRAD will see through a hurricane's heaviest rains and thickest clouds to measure strong winds at the ocean surface. These measurements will help improve models used to forecast hurricanes.

Another instrument in development is the High-Altitude Imaging Wind and Rain Airborne Radar. HIWRAP is a Doppler radar that will fly on high-altitude aircraft and provide a three-dimensional view of hurricane winds and precipitation.

Also, an instrument named TWiLiTE will measure wind profiles in clear air near storms. TWiLiTE stands for the Tropospheric Wind Lidar Technology Experiment.

NASA is forming a hurricane science team that will use NASA satellite and field data to research hurricanes. Research topics will include hurricane formation, intensification and precipitation. The team will also research the role of Saharan air in limiting hurricane formation.