

How can we measure and compare hurricanes?



There are reports that global warming will make hurricanes more intense.

Carol Tear looks at measurements used to compare tropical cyclones, and data from past cyclones

Tropical cyclones are tropical storms that have wind speeds of at least 74 mph (about 118 km/hr). These tropical cyclones are called hurricanes, typhoons or cyclones, depending on the parts of the world they affect.

How are hurricanes formed?

Hurricanes form over warm ocean water near the equator. The warm air evaporates water and rises upwards, forming an area of low air pressure below.

The water vapour condenses, forming clouds.

At sea level cooler air from the surroundings moves in, and because the Earth is rotating the air does not move directly to the centre of the low pressure but starts to swirl around it. Storms south of the equator spin clockwise and storms north of the equator spin anticlockwise.

The warming process continues and the whole system grows larger. As the storm rotates faster, a calm centre called the 'eye' forms. When the wind speeds reach 39 mph, it is called a tropical storm. To reach the 74 mph wind speed of a hurricane, the ocean water must have a temperature of at least 26.5°C for a depth of 50 m. A large difference in wind speed and direction around the storm can weaken it, so that it does not form a hurricane. Warmer water may make hurricanes stronger, but other factors may weaken them.

Table 1 Saffir–Simpson scale

Category	Wind speed/mph	Damage at landfall
1	74–95	Minimal
2	96–110	Moderate
3	111–130	Extensive
4	131–155	Extreme
5	Over 155	Catastrophic

Measuring hurricanes

Sometimes data compares the number of deaths caused by a hurricane, or the financial cost, but these depend on the path of the hurricane, and how much warning forecasters can give of its approach. The Saffir–Simpson scale (Table 1) categorises hurricanes from 1–5 based on the wind speed in the outer wall.

There are three main methods of measuring wind speed. The first is to use a dropsonde. This is a package of instruments with a parachute and a radio transmitter. It is dropped from an aircraft and sends the data as it descends through the storm. The second method is to have the instruments on aircraft that are flown into the storm, and the third is to use radar data from satellites.

Although wind speed is an indicator of the damage to be expected from a hurricane, there are other factors involved. A larger amount of rain and a high storm surge can also increase the damage. A storm surge is how much the sea level rises as a result of the low pressure, and it can cause flooding. Other important factors are how large an area the hurricane covers and how fast the whole storm moves. Moving slowly over the land means that there is more rainfall, and the high winds last for longer, causing more damage.

Accumulated cyclone energy

Accumulated cyclone energy (ACE) is another measure used to compare the activity of tropical cyclones. The maximum sustained wind speeds in knots (1 knot is 1.85 km/hr) at 6-hour intervals are used to produce an index value. The speeds are only included for the time they are greater than 74 mph –

while the storm is classed as a hurricane. The index can also be calculated for a group of hurricanes, such as all those in a month or a season. The calculation sums the squares of the maximum sustained winds and the final figure is divided by 10 000 to make it a more manageable number.

The index is related to the kinetic energy in the hurricane, because kinetic energy is proportional to speed squared, and because it takes into account how long the hurricane lasts. However, it is not a measure of the kinetic energy because the mass of air and water vapour that is moving is not included. ACE indices have been calculated for all years where we have data, but for those years before 1960, when satellite monitoring began, the data probably underestimates the number of hurricanes. In earlier years the measurements may have been less accurate too.

Hurricanes since 1961

The ACE index for the hurricanes each year since 1961 shows that there are now fewer ‘below normal’ and more ‘above normal’ years. This year (2024) has already been ‘extremely active’, but the year is not over at the time of writing. On 2 July 2024 Hurricane Beryl was the earliest category 5 hurricane to form. Hurricane Helene was huge, 400 miles across, which contributed to a destructive storm surge. It also carried a lot of water vapour, so brought heavier rain. Hurricane Milton (category 5) had very strong winds because the water was warmer than usual, and it formed many tornadoes.

Weblink

Information from NASA on hurricane formation:
<https://tinyurl.com/5anwykm7>

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