

Hurricanes for Dummies!

Hurricanes form mostly from June through November (hurricane season).

The birth of a hurricane requires at least four conditions:

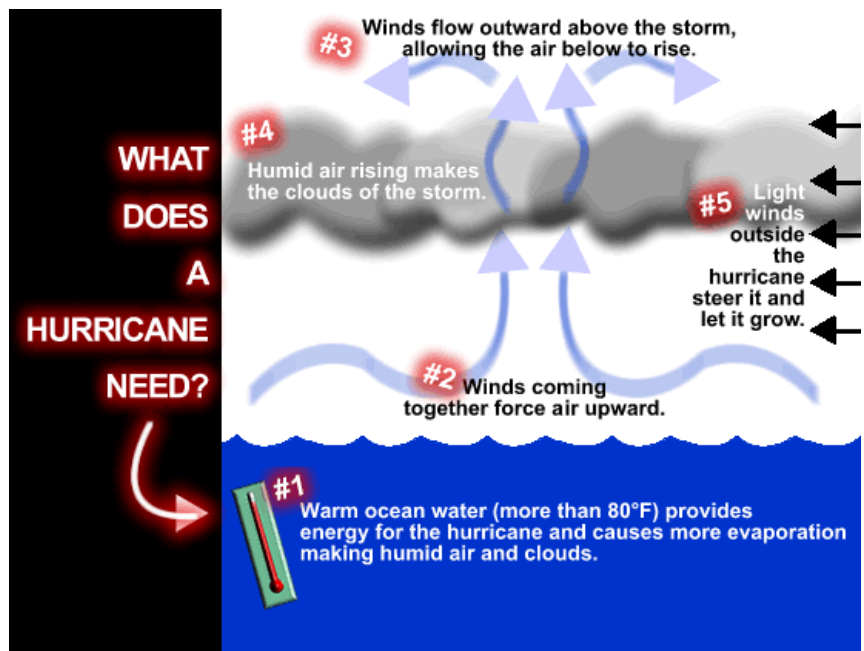
1. The ocean waters must be warm enough (80 degrees F) at the surface to put enough heat and moisture into the atmosphere to provide the energy a hurricane needs.
2. Atmospheric moisture from sea water evaporation must combine with that heat and energy to form the powerful engine needed to propel a hurricane.
3. A wind pattern must be near the ocean surface to spirals air inward. Bands of thunderstorms form, allowing the air to warm further and rise higher into the atmosphere. If the winds at these higher levels are relatively light, this structure can remain intact and grow stronger: the beginnings of a hurricane!

A hurricane goes through many stages as it develops:

1. It starts as a **tropical wave**, a westward-moving area of low air pressure.
2. As the warm, moist air over the ocean rises in the low air pressure area, cold air from above replaces it. This produces strong gusty winds, heavy rain and thunderclouds that is called a **tropical disturbance**.
3. As the air pressure drops and there are sustained winds up to 38 miles per hour, it is called a **tropical depression**.
4. When the cyclonic winds have sustained speeds from 39 to 73 miles per hour, it is called a **tropical storm** (storms are given names when they begin to have winds of this speed).
5. The storm becomes a **hurricane** when there are sustained winds of over 73 miles per hour.

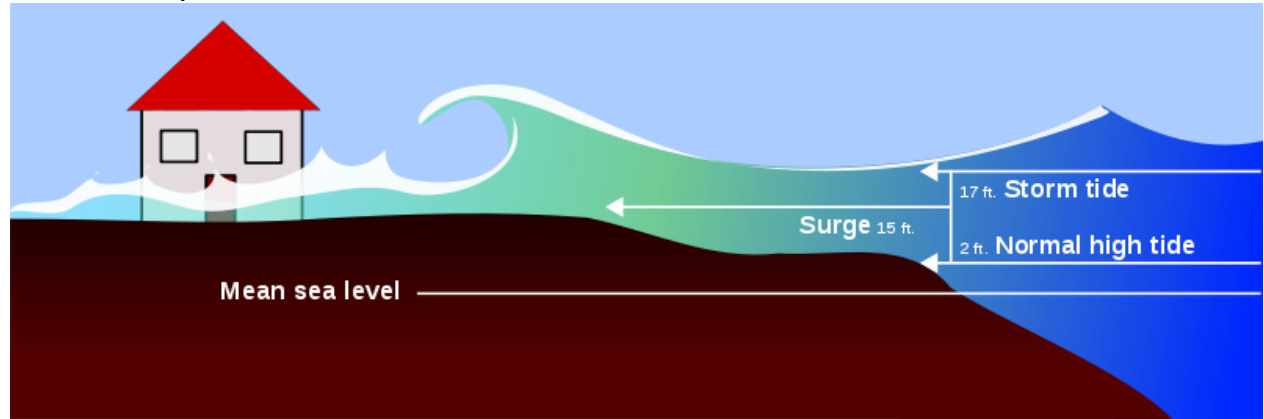
The End of a Storm:

When a hurricane travels over land or cold water, its energy source (warm water) is gone and the storm weakens, quickly dying.



A Hurricanes Biggest Threat: Storm Surge

A **storm surge** is an offshore rise of water associated with a low pressure weather system, typically hurricanes. Storm surges are caused primarily by high winds pushing on the ocean's surface. The wind causes the water to pile up higher than the ordinary sea level.



In areas where there is a significant difference between low tide and high tide, storm surges are particularly damaging when they occur at the time of a high tide. In these cases, this increases the difficulty of predicting the magnitude of a storm surge since it requires weather forecasts to be accurate to within a few hours. Storm surges can be produced by extra tropical cyclones, such as the Night of the Big Wind of 1839 and the Storm of the Century (1993), but the most extreme storm surge events typically occur as a result of tropical cyclones. Factors that determine the surge heights for landfalling tropical cyclones include the speed, intensity, size of the radius of maximum winds (RMW), radius of the wind fields, angle of the track relative to the coastline, the physical characteristics of the coastline and the bathymetry of the water offshore.

- The Galveston Hurricane of 1900, a Category 4 hurricane that struck Galveston, Texas, drove a devastating surge ashore; between 6,000 and 12,000 lives were lost, making it the deadliest natural disaster ever to strike the United States.
- Hurricane Katrina had a storm surge of approximately 28 feet.
- Hurricane Sandy's storm surge is estimate to have been between 11-15 feet.

America's Worst Hurricanes

Total economic damage from Hurricane Sandy could reach over \$50 billion, according to estimates from forecasting firm Eqecat. Widespread power and transportation outages boosted damage well past early estimates.

Sandy would rank second to Katrina, which caused \$106 billion in damage when adjusted for inflation. Though less powerful, the 2005 storm was devastating due to its concentration, the low elevation of New Orleans, and insufficient levees.

Here's a pre-Sandy chart of the costliest hurricanes adjusted for inflation from the National Weather Service:

| Ranked Using 2010 Deflator* | | | | |
|-----------------------------|----------------------------|------|----------|--------------------|
| RANK | TROPICAL CYCLONE | YEAR | Category | Damage (Millions)* |
| 1 | KATRINA (LA/MS/FL) | 2005 | 3 | \$105,840 |
| 2 | ANDREW (SE FL/SE LA) | 1992 | 5 | 45,561 |
| 3 | IKE (Upper TX/SW LA) | 2008 | 2 | 27,790 |
| 4 | WILMA (SW/SE FL) | 2005 | 3 | 20,587 |
| 5 | IVAN (NW FL/AL) | 2004 | 3 | 19,832 |
| 6 | CHARLEY (SW FL) | 2004 | 4 | 15,820 |
| 7 | HUGO (SC) | 1989 | 4 | 12,775 |
| 8 | RITA (LA/TX/FL) | 2005 | 3 | 11,797 |
| 9 | AGNES (FL/NE U.S.) | 1972 | 1 | 11,760 |
| 10 | BETSY (SE FL/SE LA) | 1965 | 3 | 11,227 |
| 11 | ALLISON (N TX) | 2001 | TS | 10,998 |
| 12 | FRANCES (SE FL) | 2004 | 2 | 10,018 |
| 13 | CAMILLE (MS/SE LA/VA) | 1969 | 5 | 9,282 |
| 14 | FLOYD (Mid Atlc & NE U.S.) | 1999 | 2 | 9,225 |
| 15 | JEANNE (SE FL) | 2004 | 3 | 8,072 |
| 16 | OPAL (NW FL/AL) | 1995 | 3 | 7,729 |
| 17 | DIANE (NE U.S.) | 1955 | 1 | 7,408 |
| 18 | FREDERIC (AL/MS) | 1979 | 3 | 6,571 |
| 19 | New England | 1938 | 3 | 6,325 |
| 20 | FRAN (NC) | 1996 | 3 | 6,140 |
| 21 | ISABEL (NC/VA) | 2003 | 2 | 6,112 |
| 22 | CELIA (S TX) | 1970 | 3 | 5,918 |
| 23 | NE U.S. | 1944 | 3 | 5,706 |
| 24 | ALICIA (N TX) | 1983 | 3 | 4,569 |
| 25 | GUSTAV (LA) | 2008 | 2 | 4,347 |
| 26 | CAROL (NE U.S.) | 1954 | 3 | 4,175 |
| 27 | GEORGES (FL, LA, MS) | 1998 | 2 | 3,860 |
| 28 | JUAN (LA) | 1985 | 1 | 3,238 |
| 29 | DONNA (FL/Eastern U.S.) | 1960 | 4 | 3,215 |
| 30 | BOB (NC, NE U.S) | 1991 | 2 | 2,703 |
| ADDENDUM | | | | |
| 30 | INIKI (Kauai, HI) | 1992 | 4 | 3,095 |
| 30+ | GEORGES (USVI,PR) | 1998 | 3 | 2,513 |
| 30+ | MARILYN (USVI,E. PR) | 1995 | 2 | 2,255 |
| 30+ | HUGO (USVI, PR) | 1989 | 4 | 1,825 |
| 30+ | San Felipe (PR) | 1928 | 5 | 1,757 |

As for loss of life:

| RANK | HURRICANE | YEAR | CATEGORY | DEATHS |
|------|--------------------------------|------|-----------------|------------------------|
| 1 | TX (Galveston) | 1900 | 4 | 8000 ^a |
| 2 | FL (SE/Lake Okeechobee) | 1928 | 4 | 2500 ^b |
| 3 | KATRINA (SE LA/MS) | 2005 | 3 | 1200 |
| 4 | LA (Cheniere Caminanda) | 1893 | 4 | 1100-1400 ^c |
| 5 | SC/GA (Sea Islands) | 1893 | 3 | 1000-2000 ^d |
| 6 | GA/SC | 1881 | 2 | 700 |
| 7 | AUDREY (SW LA/N TX) | 1957 | 4 | 416 ^h |
| 8 | FL (Keys) | 1935 | 5 | 408 |
| 9 | LA (Last Island) | 1856 | 4 | 400 |
| 10 | FL (Miami)/MS/AL/Pensacola | 1926 | 4 | 372 |
| 11 | LA (Grand Isle) | 1909 | 3 | 350 |
| 12 | FL (Keys)/S TX | 1919 | 4 | 287 ^o |
| 13 | LA (New Orleans) | 1915 | 3 | 275 ⁱ |
| 13 | TX (Galveston) | 1915 | 4 | 275 |
| 15 | New England | 1938 | 3 | 256 ⁿ |
| 15 | CAMILLE (MS/SE LA/VA) | 1969 | 5 | 256 |
| 17 | DIANE (NE U.S.) | 1955 | 1 | 184 |
| 18 | GA, SC, NC | 1898 | 4 | 179 |
| 19 | TX | 1875 | 3 | 176 |
| 20 | SE FL | 1906 | 3 | 164 |
| 21 | TX (Indianola) | 1886 | 4 | 150 |
| 22 | MS/AL/Pensacola | 1906 | 2 | 134 |
| 23 | FL, GA, SC | 1896 | 3 | 130 |
| 24 | AGNES (FL/NE U.S.) | 1972 | 1 | 122 ^f |
| 25 | HAZEL (SC/NC) | 1954 | 4 | 95 |
| 26 | BETSY (SE FL/SE LA) | 1965 | 3 | 75 |
| 27 | Northeast U.S. | 1944 | 3 | 64 ^g |
| 28 | CAROL (NE U.S.) | 1954 | 3 | 60 |
| 29 | FLOYD (Mid Atlantic & NE U.S.) | 1999 | 2 | 56 |
| 30 | NC | 1883 | 2 | 53 |
| 31 | SE FL/SE LA/MS | 1947 | 4 | 51 |
| 32 | NC, SC | 1899 | 3 | 50 ^{h,j} |
| 32 | GA/SC/NC | 1940 | 2 | 50 |
| 32 | DONNA (FL/Eastern U.S.) | 1960 | 4 | 50 |
| 35 | LA | 1860 | 2 | 47 ^h |
| 36 | NC, VA | 1879 | 3 | 46 ^{h,j} |
| 36 | CARLA (N & Central TX) | 1961 | 4 | 46 |
| 38 | TX (Velasco) | 1909 | 3 | 41 |
| 38 | ALLISON (SE TX) | 2001 | TS ^x | 41 |
| 40 | Mid-Atlantic | 1889 | TS ⁱ | 40 ^{h,j} |
| 40 | TX (Freeport) | 1932 | 4 | 40 |
| 40 | S TX | 1933 | 3 | 40 |

| RANK | HURRICANE | YEAR | CATEGORY | DEATHS |
|------|-------------------------|------|-----------------|-------------------|
| 43 | HILDA (LA) | 1964 | 3 | 38 |
| 44 | SW LA/Upper TX | 1918 | 3 | 34 |
| 45 | SW FL | 1910 | 3 | 30 |
| 45 | ALBERTO (NW FL, GA, AL) | 1994 | TS ^x | 30 |
| 47 | SC, FL | 1893 | 3 | 28 ^m |
| 48 | New England | 1878 | 2 | 27 ^{h,n} |
| 48 | Texas | 1886 | 2 | 27 ^h |
| 50 | ANDREW (S FL, LA) | 1992 | 5 | 26 |
| 50 | FRAN (NC) | 1996 | 3 | 26 |
| 52 | LA | 1926 | 3 | 25 |
| 52 | CONNIE (NC) | 1955 | 3 | 25 |
| 52 | IVAN (NW FL, AL) | 2004 | 3 | 25 |

ADDENDUM (Not Atlantic/Gulf Coast)

| RANK | HURRICANE | YEAR | CATEGORY | DEATHS |
|------|----------------------------------|------|-----------------|-------------------|
| 2 | Puerto Rico (San Ciriaco) | 1899 | 3 | 3369 ^l |
| 6 | P.R., USVI (San Narciso) | 1867 | 3 | 811 ^o |
| 6 | Puerto Rico (San Lorenzo) | 1852 | 1 | 800 ^o |
| 12 | Puerto Rico (San Felipe) | 1928 | 5 | 312 |
| 17 | USVI, P.R. (San Ciprian) | 1932 | 2 | 225 |
| 25 | DONNA (St. Thomas, VI) | 1960 | 4 | 107 |
| 25 | Puerto Rico (San Gil) | 1888 | 1 | 100 ^h |
| 38 | Southern California | 1939 | TS ^x | 45 |
| 38 | ELO/SE (Puerto Rico) | 1975 | TS ^x | 44 |
| 48 | USVI (Santa Juana ⁿ) | 1871 | 3 | 27 ^h |
| 52 | Puerto Rico (San Liborio) | 1926 | 2 | 25 |

Notes:

- a Could be as high as 12,000
- b Could be as high as 3000
- c Total including offshore losses near 2000
- d August
- e Total including offshore losses is 600
- f No more than
- g Total including offshore losses is 390
- h At least
- i Puerto Rico 1899 and NC, SC 1899 are the same storm
- j Could include some offshore losses
- k Only of Tropical Storm intensity.
- l Remained offshore
- m Mid-October
- n Four deaths at shoreline or just offshore
- o Possibly a total from two hurricanes