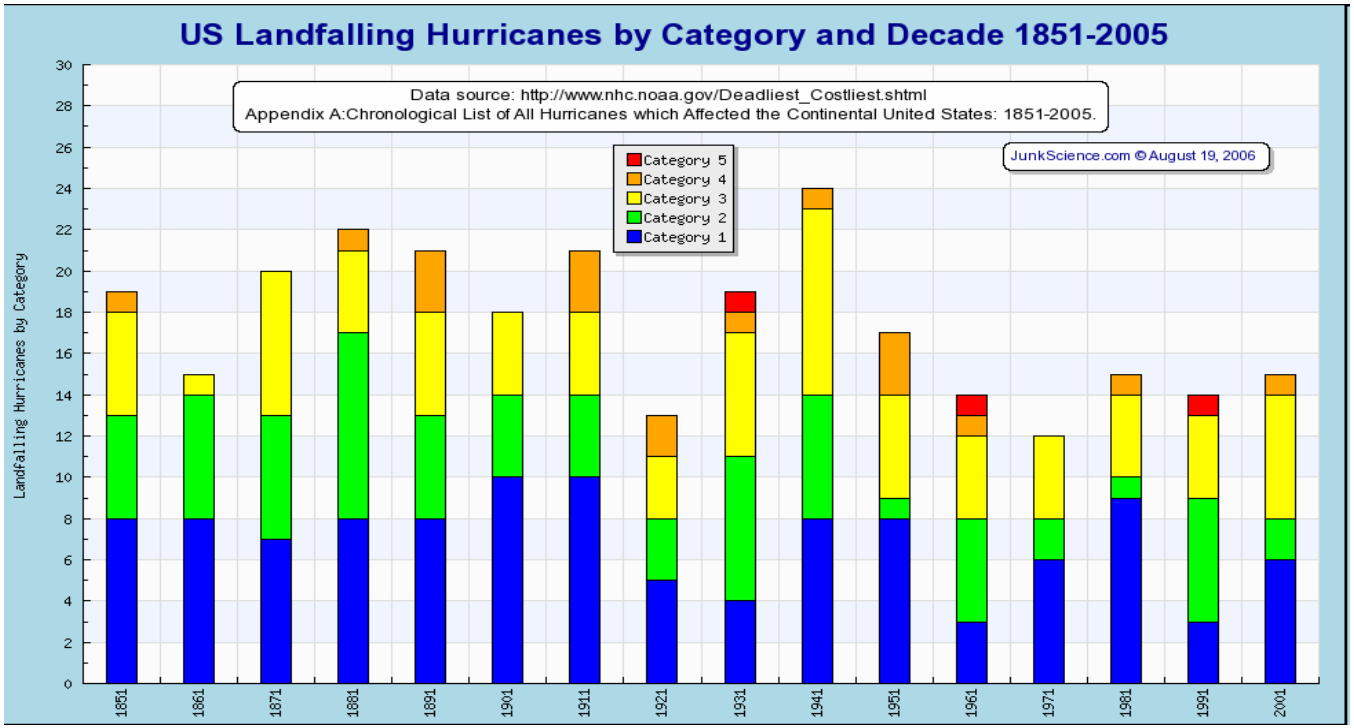
Lab 8

Goals:

- 1. To understand the basics of what hurricanes are, why they form, and how they behave.
- 2. To consider how extreme weather events affect society.
- 3. To address the ways in which global warming might alter hurricane formation and behavior.


US Landfalling Hurricanes by Category and Decade 1851-2005
Data source: http://www.nhc.noaa.gov/Deadliest_Costliest.shtml
Appendix A:Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005.
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Category 5
Category 4
Category 3
Category 2
Category 1
Landfalling Hurricanes by Category
0
2
4
6
8
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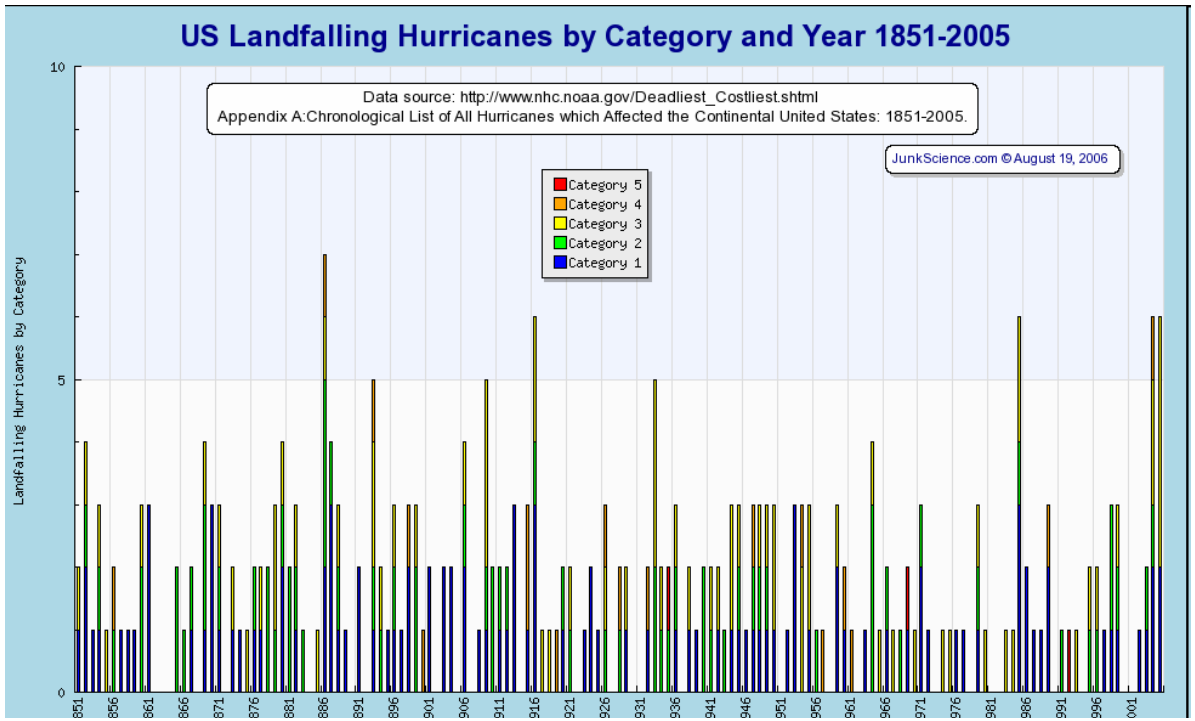
US Landfalling Hurricanes by Category and Year 1851-2005
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Category 5
Category 4
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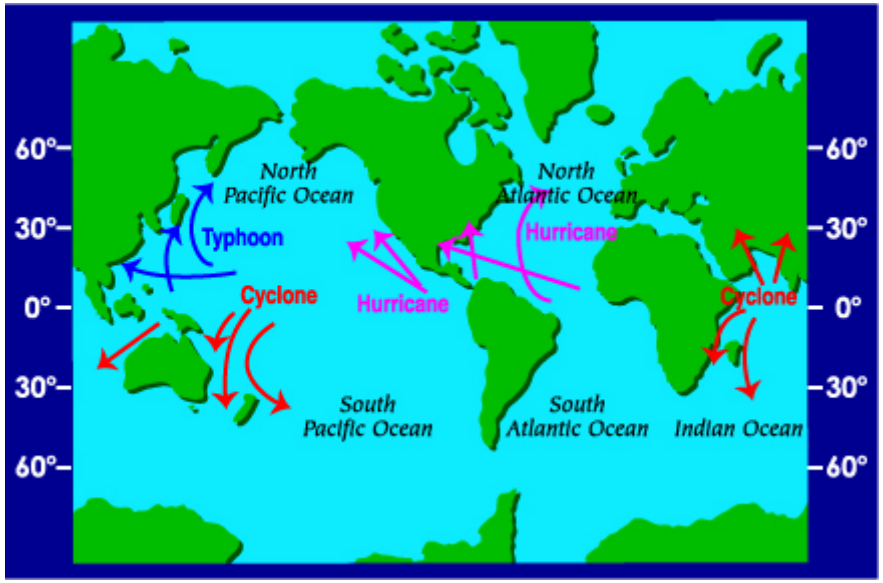
Landfalling Hurricanes by Category
0
5
10

What is a hurricane?

- An intense storm formed over warm tropical waters (northern Atlantic and eastern North Pacific oceans), with winds exceeding 74mi/hr.
- It is called a typhoon in the western North Pacific, a cyclone in India and a tropical cyclone in Australia. Tropical cyclone is the general term for all hurricane-type storms.

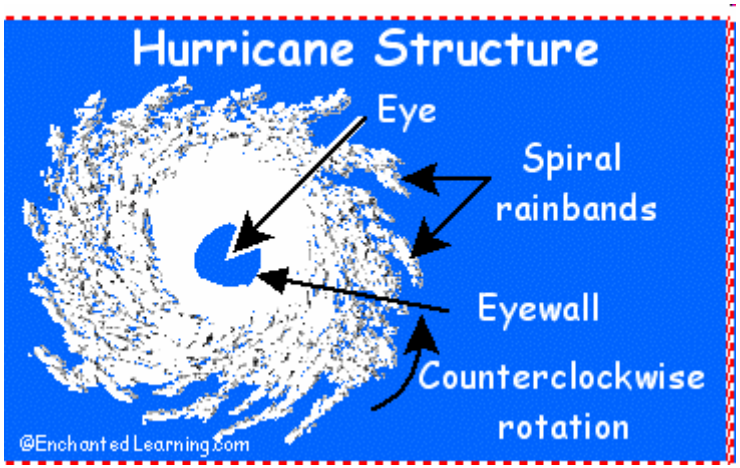


Five necessary conditions

- 1. The existence of low pressure areas at the surface
- 2. A warm, moist tropical atmosphere that promotes rising air
- 3. Ocean surface temperatures greater than 26–27ºC
- 4. Very little change in wind speed and wind direction with height in the atmosphere.
- 5. A sufficiently strong Coriolis force

Structure of a hurricane

- http://scifiles.larc.nasa.gov/kids/Problem_Board/problems/weather/hurricanebasics.swf



How do hurricanes form?

- Certain necessary ingredients are required before a weak tropical disturbance will develop into a fully-fledged hurricane.
- Form over tropical waters where the winds are light, the humidity is high and the surface water temperature is warm (>=80°F)
- Some are attributed to tropical waves that form over Africa, when the western part of Africa is relatively wet.
- Most hurricanes that hit the United States begin either in the Caribbean or the Atlantic. Many of the worst start as seedlings coming off the coast of Africa.

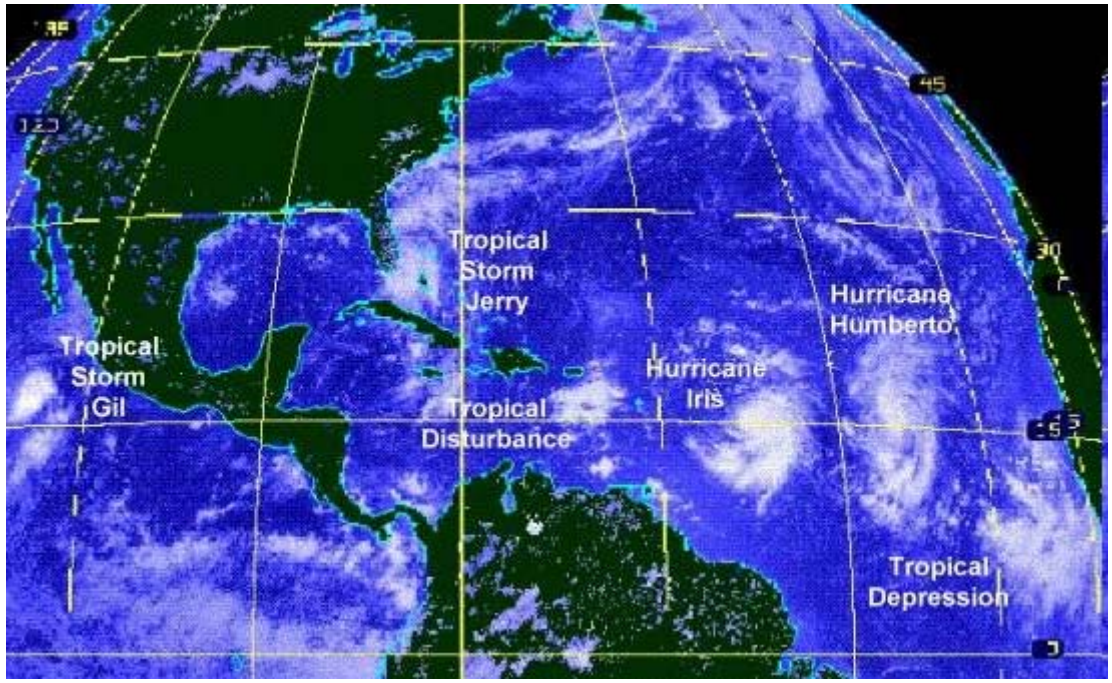
- **Knots Versus Miles per Hour**
- **Knots** is how the speed of aircraft and boats is measured. Both miles per hour and knots is a speed which is the number of units of distance that is covered for a certain amount of time.
- 1 knot = 1 nautical mile per hour = 6076 feet per hour
  1 mph =1 mile per hour = 5280 feet per hour

answers

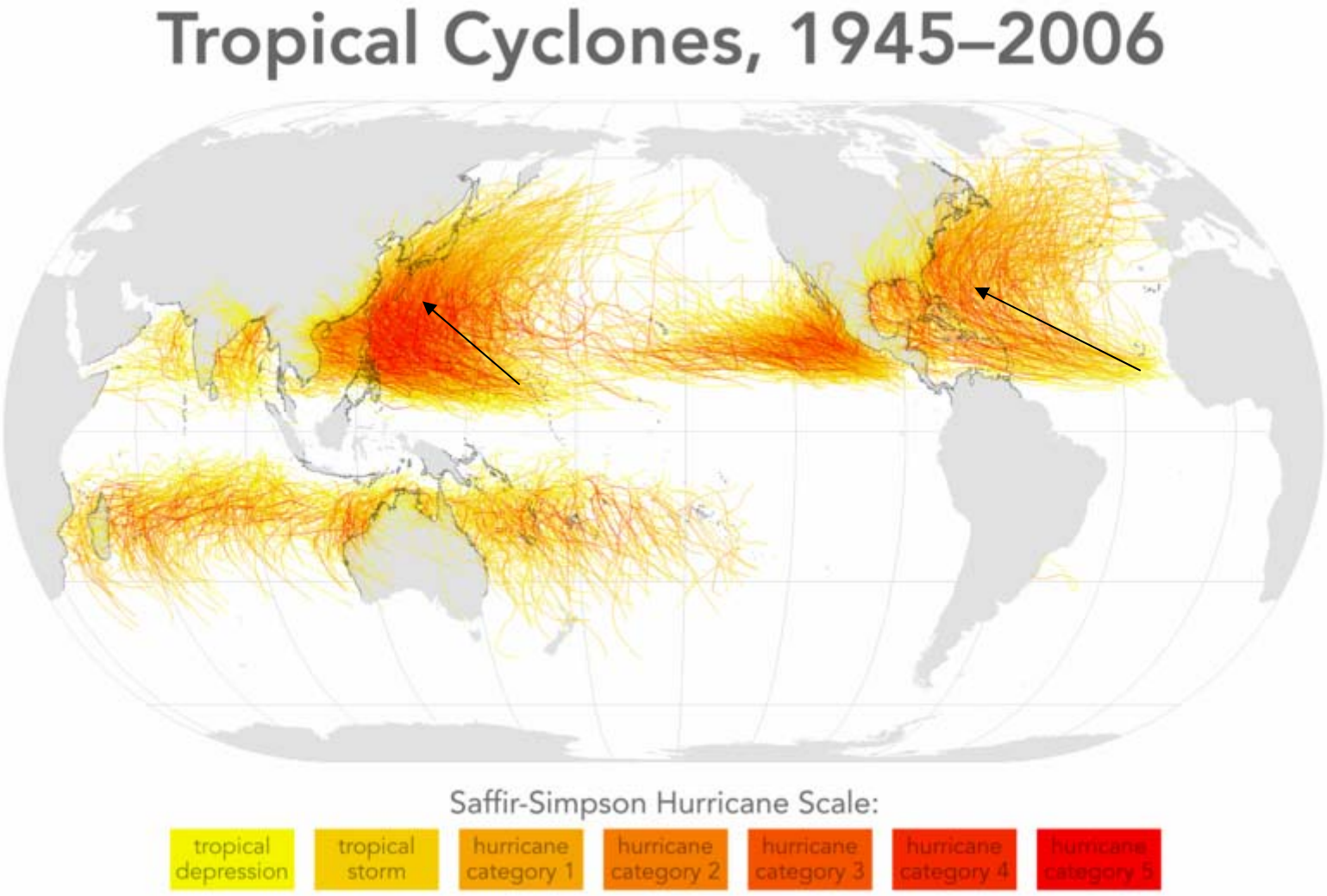
Knots	MPH
2	**2.3**
8.7	10
58	**66.7**
55.6	64
110	**126.6**
217.2	250

Hurricane stages of development

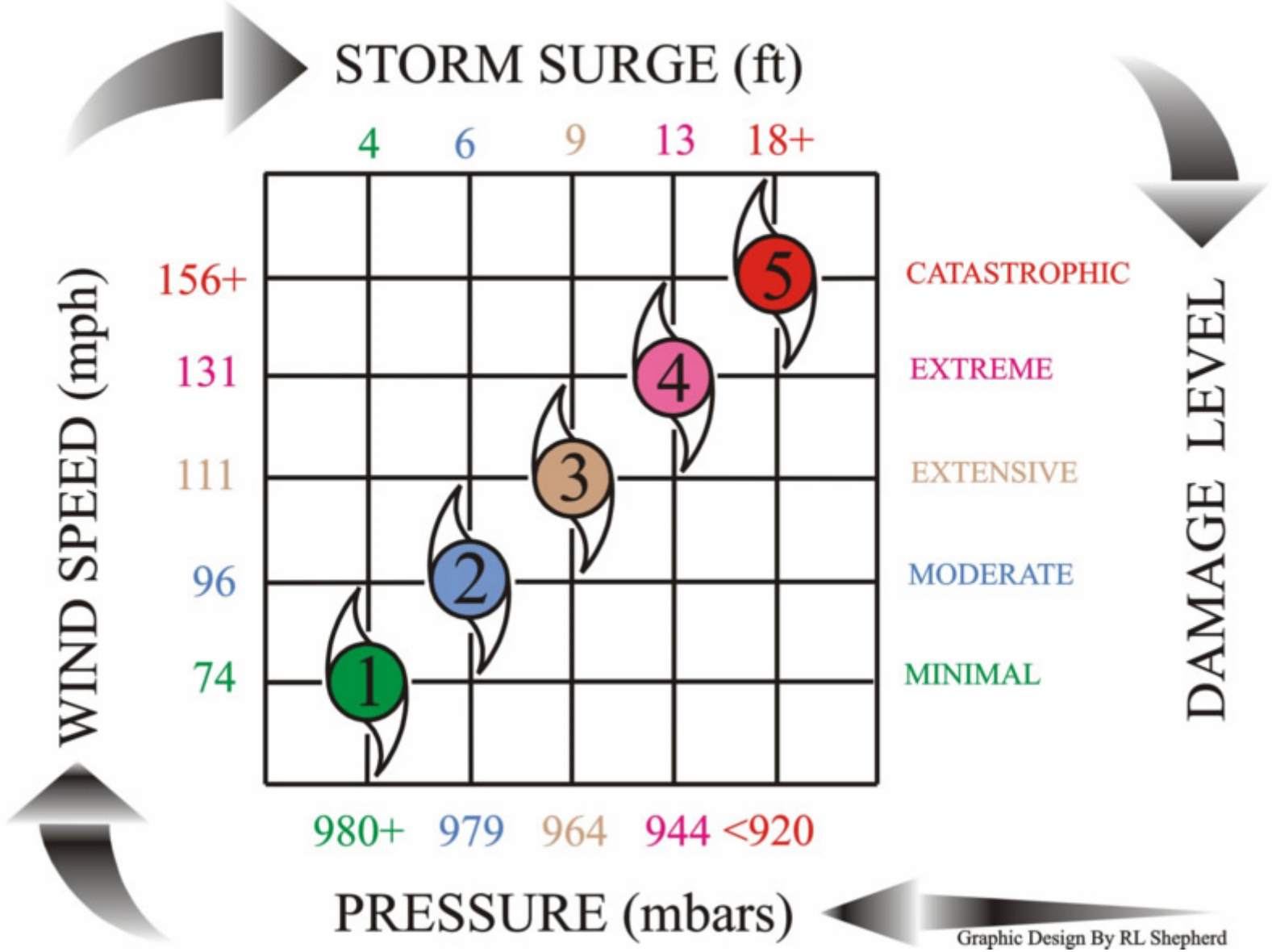
- Hurricanes go through a set of stages from birth to death. Initially, the mass of thunderstorms with only a slight wind circulation is known as a tropical disturbance or tropical waver.
- The tropical disturbance becomes a tropical depression when the winds increase to between 20—34 knots
- When the winds are between 34-64knots, the tropical depression becomes a tropical storm. If the winds exceed 64 knots, the storm is classified as a hurricane.



Hurricane paths



SAFFIR-SIMPSON HURRICANE SCALE



Naming a hurricane

- Although hurricanes have been around for a long time, the naming of hurricanes started in 1953. At first, they only used female names. People would use the names of their girlfriends, wives, and daughters. One hurricane was named after Bess Truman, the first lady of president Truman. In 1979, a woman's organization started protesting that men's names should also be used to name hurricanes.
- Since then, six lists of names have been created. Now at the beginning of each season, a new list is drawn up. They start with names that begin with "a" and slowly go down the list.
- When a hurricane has caused enough damage and destruction, its name is retired and never used again.

Deadliest Hurricanes in the United States (U.S. Mainland)

Rank	Hurricane	Year	Category[2]	Deaths
1.	Galveston, Tex.	1900	4	8,000[3]
2.	Lake Okeechobee, Fla.	1928	4	2,500
3.	Katrina (La./Miss.)	2005	3	1,800[4]
4.	Florida Keys/S. Tex.	1919	4	600[5]
5.	New England	1938	3	600
6.	Florida Keys	1935	5	408
7.	Audrey (SW La./N. Tex.)	1957	4	390
8.	NE U.S.	1944	3	390[6]
9.	Grand Isle, La.	1909	4	350
10.	New Orleans, La.	1915	4	275
10.	Galveston, Tex.	1915	4	275

Most Intense Hurricanes in the United States

Rank	Hurricane	Year	Category[3]
1.	Florida Keys	1935	5
2.	Camille (Miss./La./Va.)	1969	5
3.	Katrina (La./Miss.)[4]	2005	3
4.	Andrew (Fla./La.)	1992	5
5.	Indianola, Tex.	1886	4
6.	Florida Keys/Tex.	1919	4
7.	Lake Okeechobee, Fla.	1928	4
8.	Donna (Fla./Eastern U.S.)	1960	4
9.	New Orleans, La.	1915	4
9.	Carla (Tex.)	1961	4
11.	Last Island, La.	1856	4
11.	Hugo (S.C.)	1989	4

Costliest Hurricanes in the United States (U.S. Mainland)

Rank	Hurricane	Location	Year	Cate-gory[2]	Damage (in billions)
1.	Katrina	La./Miss.	2005	3	$96.0[3]
2.	Andrew	Fla./La.	1992	5	26.5
3.	Charley	Fla.	2004	4	15.0
4.	Wilma	Fla.	2005	3	14.4[3]
5.	Ivan	Ala./Fla.	2004	3	14.2
6.	Rita	Tex./La.	2005	3	$9.4[3]
7.	Frances	Fla.	2004	2	8.9
8.	Hugo	S.C.	1989	4	7.0
9.	Jeanne	Fla.	2004	3	6.9
10.	Allison	Tex.	2001	TS[4]	5.0

Hurricane Katrina

- http://www.truveo.com/NOVA-Storm-That-Drowned-a-City-Upgrading-the/id/956992944

- Researchers led by James Elsner, a meteorologist at Florida State University, analyzed satellite-derived data of tropical storms since 1981 and found that the maximum wind speeds of the strongest storms have increased significantly in the years since, with the most notable increases found in the North Atlantic and the northern Indian oceans. They believe that rising ocean temperatures — due to global warming — are one of the main causes behind that change.
- http://www.sciencedaily.com/releases/2008/08/080812160615.htm

Global Warming Will Do Little To Change Hurricane Activity, According To New Model - Microsoft Internet Explorer

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Science News

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Global Warming Will Do Little To Change Hurricane Activity, According To New Model

ScienceDaily (Aug. 13, 2008) — In a study published in the July 2008 issue of Geophysical Research Letters, Drs. David S. Nolan and Eric D. Rappin from the University of Miami's Rosenstiel School of Marine and Atmospheric Science describe a new method for evaluating the frequency of hurricane formation in present and future tropical climates.

See also:

Earth & Climate
- Hurricanes and Cyclones
- Severe Weather
- Climate

Computers & Math
- Computer Modeling
- Computer Science
- Mathematical Modeling

Reference
- Planetary boundary layer
- National Hurricane

While current thinking about changes in hurricane frequency comes mostly from computer simulations of global climate, the computer models used for these studies can only represent the coarsest features of hurricanes, thus casting doubt in their predictions of hurricane activity.

The new approach by Nolan and Rappin, developed in collaboration with Dr. Kerry Emanuel of the Massachusetts Institute of Technology, uses computer models with much more accurate representation of the processes that lead to hurricane formation, much

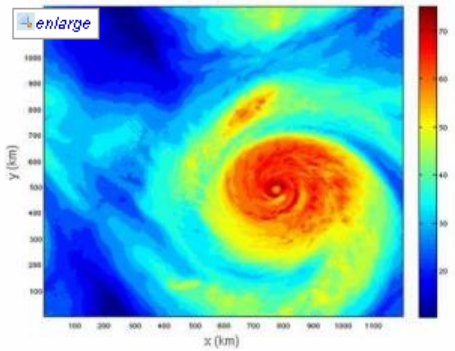

Figure shows an example of a hurricane computer simulation generated by the Rosenstiel School team. The colors indicate water vapor in a vertical column of the atmosphere, where the dark red areas would indicate extremely heavy rainfall. The small size of each pixel, 3 km x 3 km provides remarka… the storm. In compar… …ls in an image used to repre… …imate models are typically… …est. (Credit: UW/RSMAS)

small
small [简明英汉词典]
adj.小的，少的

Just In:
Cooperation Meshes With Evolutionary Theory

Science Video News

Our Changing Climate
Geographers have projected temperature increases due to greenhouse gas emissions to reach a not-so-chilling conclusion: climate zones will shift and. … > *full story*

- Meteorologists See Future of Increasingly Extreme Weather Events
- Atmospheric Scientists' Model Predicts Hurricane Threat Months In Advance
- Research Meteorologists See More Severe Storms Ahead: The Culprit -- Global Warming
- *more science videos*

Done Unknown Zone (Mixed)

- The simulations show that if they do form, hurricanes become stronger in the warmer environments. Together, these results suggest that in a global warming world, there would be less hurricanes, but those that do form could become stronger. The same prediction has recently been made by other studies using global climate models, and the similarity of the two predictions enhances confidence in the results.