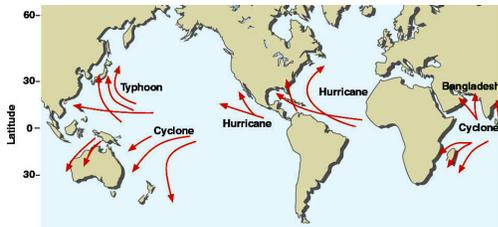


Chapter 16, Part 2

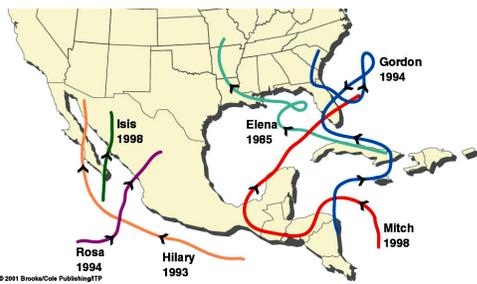
Hurricane Paths and Damage

1. Hurricane Paths



- Start over tropical water except South Atlantic and eastern South Atlantic, where water is too cold.
- Initially steered by easterly winds at ~10 knots.
- Eventually swing poleward around subtropical high.

2. Hurricane Paths

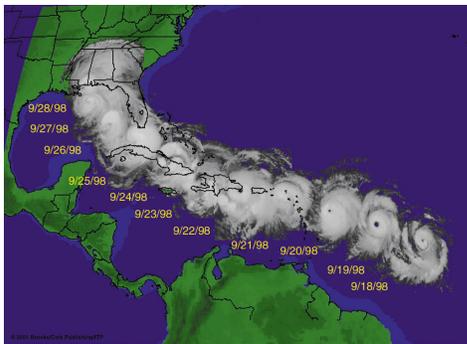


- Actual paths vary considerably and are difficult to predict.

3. Hurricane Paths

- Hurricanes born off coast of Mexico usually move westward away from coast, but some move to NW or even N or NE.
- Hawaiian Islands (20°-23°N) in direct path of hurricanes, but most storms weakened by time they reach there.
- Hurricanes formed over N. Atlantic move towards Central and N. America. Most swing away from land and move N. along coast. Approx. 3 per year move inland.

Path of Hurricane Georges

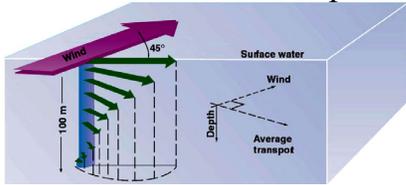


Hurricane Wind Distribution



- Shown: Hurricane Gloria (1985).
- Stronger winds on eastern side because the hurricane is moving to the north.

Review of Ekman Spiral

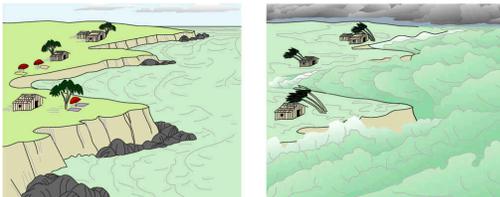


- Winds set water in motion.
- Each successive layer below travels to the right of the layer above in the northern hemisphere.
- If the winds are from north to south, then there will be a component of water flow from west to east.

Flooding

- North wind on western side of Hurricane Gloria causes a net transport of water toward the shore.
- High winds generate large waves, sometimes 10-15m high.
- Waves may move away from the hurricane in swells, which may be felt days before.
- Low pressure raises water level.
- Flooding normally causes most of the destruction.

Storm Surge



- Combined effect of high water (L), high winds, and net Ekman transport produces a storm surge, which is usually well above the high-tide level.

Spin-up Vortices

- Based on analysis of Hurricane Andrew (1992) it has been proposed that the most severe damage comes from whirling eddies 30-100m in diameter.
- Last only about 10 seconds.
- Form in region of strong wind speed shear in hurricane's eye wall.
- Isolated wind speeds in Hurricane Andrew reached 174 knots (200 mph).

Hurricane Watch and Warning

- Information from ships, satellites, radar, buoys, reconnaissance aircraft now allow one to pinpoint hurricanes' location.
- Hurricane watch issued 24-48 hours before anticipated arrival.
- Hurricane warning issued within 24 hours of arrival. Done for a large coastal area (550km) with damage usually being on 1/3 of this length. (overwarning)
- Local authorities evacuate low lying areas.

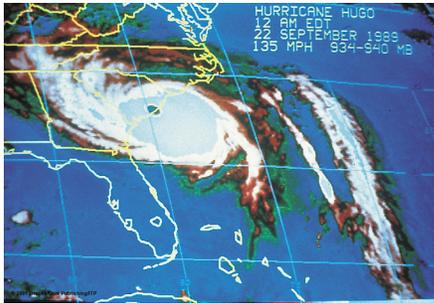
Hurricane Damage

- Annual hurricane death toll in US averaged between 50 and 100 persons, although can be larger in a big storm.
- Relatively low because of advance warning and few really intense storms reach land.
- Discuss two of them:
 - Hurricane Hugo (1989)
 - Hurricane Andrew (1992)

Hurricane Hugo (1989)

- Born off coast of Africa
- Struck St. Croix w/ sustained winds of 125 knots
- Next tip of Puerto Rico and towards South Carolina (near Charleston)
- Maximum winds at about 120 knots (138mph), central pressure, storm surge 2.5-6 m (8-20 feet).
- Total cost of damage \$7 billion, 21 dead in US.

Infrared Satellite Image of Hugo



- Eye over coast near Charleston, South Carolina.

Damage from Storm Surge

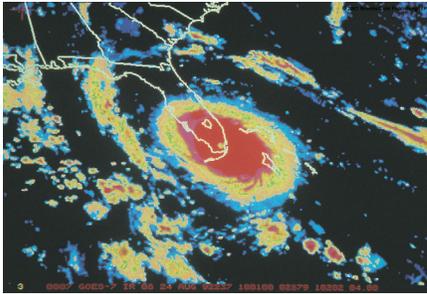


Folly Beach, South Carolina before and after Hurricane Hugo.

Hurricane Andrew (1992)

- Tropical storm on August 21, 1992.
- Moved into region of favorable development and in two days winds increased from 45 to 122 knots.
- With steady winds of 126 knots (145 mph) made landfall south of Miami on 8/24/92.
- Roared across S. Florida, weakened slightly, then regained strength in Gulf of Mexico.
- Entered Louisiana with 120 knot winds evening 8/25.
- Costliest natural disaster to hit US.

Infrared Satellite Image of Andrew



- Taken on 8/24/92. Central pressure 932 mb and sustained winds of 126 knots (145 mph).

Damage from Hurricane Andrew



- Condominiums near Homestead, Florida.

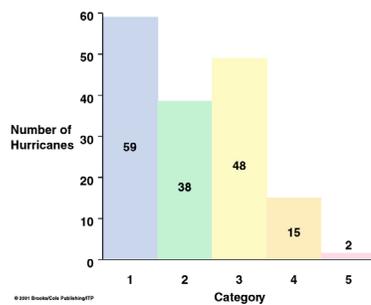
Saffir-Simpson Scale

Cat.	Central Pressure	Winds (mph)	Damage
1	>980mb	74-95	mainly trees
2	965-979	96-110	trees, mobile homes, roofs
3	945-964	111-130	“ “ + damage to small buildings
4	920-944	131-155	extensive damage to buildings
5	<920mb	>155	small buildings blown away

Most Intense Hurricanes to Strike US from 1900 to 1998

Rank	Hurricane	Year	Cat.	Death Toll
1	Florida (Keys)	1935	5	408
2	Camille	1969	5	256
3	Andrew	1992	4	53
4	Florida/Texas	1919	4	>600
5	Florida (Lake O.)	1928	4	1836
6	Donna	1960	4	50
7	Texas (Galveston)	1900	4	>6000
8	Louisiana (Gr.Isle)	1909	4	350
9	Louisiana (Orleans)	1915	4	275

Number of Hurricanes 1900-1998



- Categories 3,4,5 are considered major hurricanes.
- Most hurricanes are categories 1,2, and 3.

Naming Hurricanes

- Beginning 1953 hurricanes were given female names. Before identified by longitude, latitude.
- In 1978 male and female names were used in eastern Pacific.
- Since 1979 both male and female names were used for N. Atlantic hurricanes.
- Names predetermined in an alphabetical list.
- Storms causing great damage or Category 3 or higher have name retired for at least 10 years.

Summary

- Hurricanes form in tropical waters and move to the west and eventually poleward.
- While it is now possible to pinpoint the location of a hurricane, predicting its precise path is difficult.
- Damage from hurricanes occurs because of high winds, heavy rain, large waves, and the storm surge. Flooding causes most of damage.
- There are 5 categories of hurricanes with cat. 4 and 5 hurricanes much less common.
