

Natural Disasters

Lecture 10_a Ch 11 – Hurricanes

Text Source Today:
Chapter 11

11.1: Ch. 11 – Hurricanes

● **Hurricane:** Spanish word (Huracán) for “storm” and some say, for “*Carib God of Evil*”. Also called **typhoons** in the central and western Pacific Ocean and **tropical cyclones** in the Indian Ocean and Australia.

◆ Conditions favorable for tropical storm formation:

- ocean surface temperature exceeds **27° C (80° F)**
- warm water must extend down at least **60 m (200 feet)**
- must be at least **5° latitude** or more away from Equator (must have some **Coriolis effect** to allow for rotation)
- no significant **vertical wind shear** (in direction or speed)

● There are several “**breeding grounds**” that typically meet the above conditions. The central and western **Pacific** has the highest frequency of typhoons. Note the total absence of activity around **South America**.

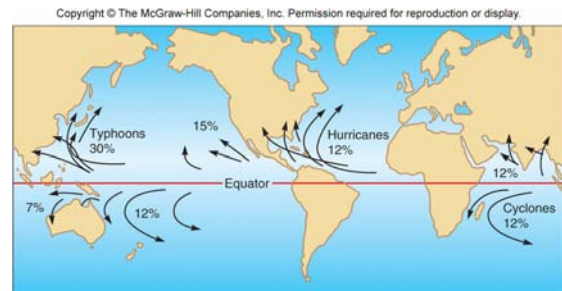
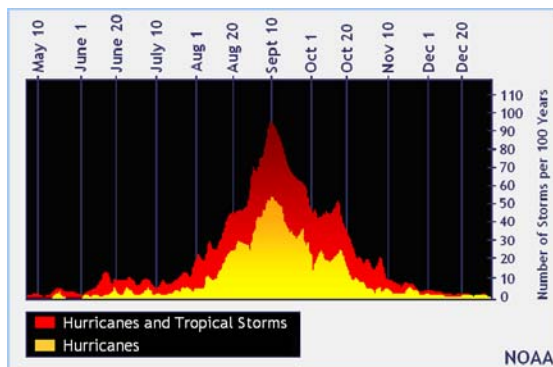


Fig. 11.11

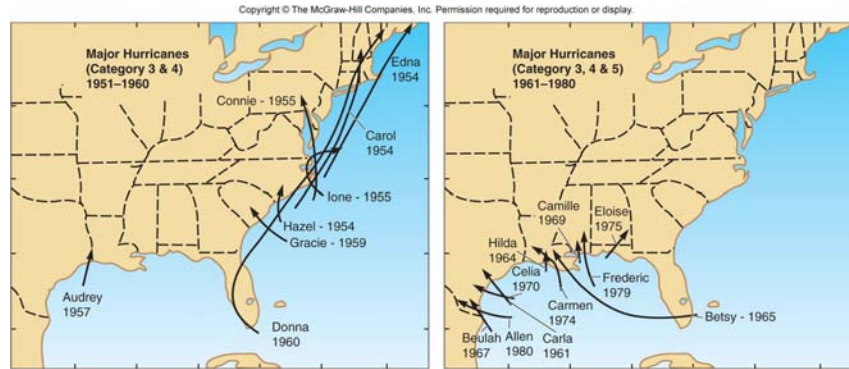


◆ The Atlantic hurricane season is from **June 1st to November 30th** (with **90%** of all hurricane days from August through October); peak date of **Sep. 10th**. The Pacific season runs all year.

● Every year, about **90 tropical storms** form globally, of which about half become **hurricanes**.

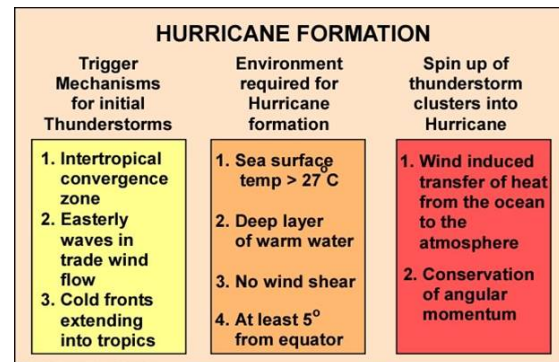
- The Atlantic hurricane season is **cyclical**, with extended periods of activity or inactivity, and even in preferred tracks. These cycles have been known to persist for a **decade** or more:

Fig. 11.18



• How a Hurricane Forms:

- Think of a hurricane as a tight, rotating cluster of **thunderstorms**, thriving on **latent and sensible heat release** for energy. If conditions are favorable, formation can begin with a “spark” as an **easterly wave** in the trade winds, or a cluster of thunderstorms that break away from the **ITCZ**, or even at the end of a **cold front** extending into the tropics.
- The resulting “**warm-core low**” sets up a “**chimney effect**” creating a near-perfect “**feedback**” mechanism (i.e., **latent heat** release causes air to rise, the surface pressure **falls**, the winds strengthen, more **moisture** arrives, more **latent heat** release causes even more air to rise, etc. etc.).



- The progression is from **tropical disturbance** to **tropical depression**, when the sustained surface winds reach **37 km/hr (23 mph)**. When the winds exceed **63 km/hr (39 mph)**, it becomes a **tropical storm** and is given a “**name**”. There are name lists for all the world breeding ground basins.

- Any country can request that a particularly deadly or destructive storm have the **name “retired”** for future research purposes (e.g., Camille, 1969; Katrina 2005).

♦ **Hurricane:** when the sustained surface winds exceed **119 km/hr (74 mph)**. In the United States, the **Saffir-Simpson** scale is used to categorize **hurricane damage potential**. A **major hurricane** is defined to be a **Category 3, 4 or 5** on the scale:

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TABLE 11.1

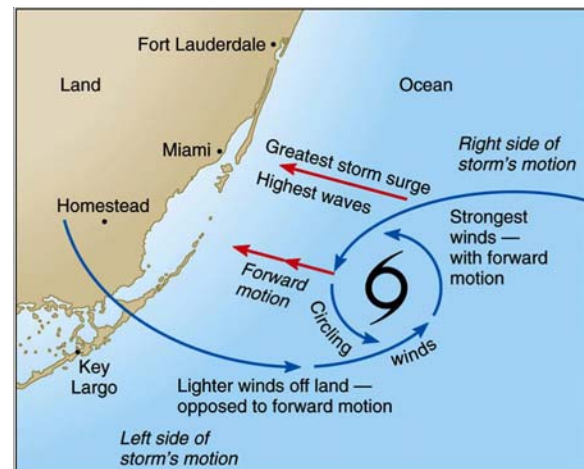
Saffir-Simpson Hurricane Damage Potential Scale

	Barometric Pressure		Wind Speed		Storm Surge		Damages
	(millibars)	(inches)	(km/hr)	(mph)	(meters)	(feet)	
Category 1	≥980	Over 28.92	119–154	74–95	1.2–1.5	4–5	Minimal
Category 2	965–979	28.50–28.91	155–178	96–110	1.8–2.4	6–8	Moderate
Category 3	945–964	27.91–28.49	179–210	111–130	2.7–3.7	9–12	Extensive
Category 4	920–944	27.17–27.90	211–250	131–155	4–5.5	13–18	Extreme
Category 5	<920	Less than 27.17	>250	Over 155	>5.5	Over 18	Catastrophic

- **Hurricane Eye:** the eye-wall is a fierce “doughnut” of thunderstorms containing the **strongest winds** surrounding the eye, which is nearly **cloudless** due to sinking air and usually has **calm to light** surface winds; it has an average diameter of 19-64 km (12-40 miles) and can take up to an hour to pass over a particular location.



♦ **Storm Surge:** is the most destructive aspect of a hurricane and occurs on the right-hand side of the eye-wall (front-right quadrant) of a land-falling hurricane. The **storm surge** is especially destructive in shallow coastal areas and is enhanced at high tide. High waves on top of the storm surge add a battering effect and increases the damage potential.



● **Other Hurricane Hazards:** **inland flooding** due to torrential rainfall (and is responsible for most U.S. hurricane deaths, due to **drowning**), wind damage and **EF0/EF1 tornadoes** (in the right-front flank).

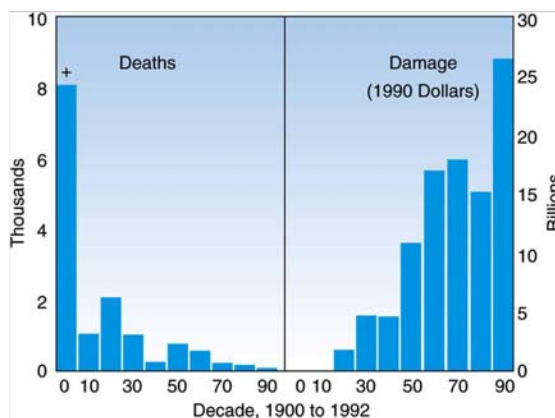
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TABLE 11.10

U.S. Hurricane Deaths, 1970–1999

Inland flooding	59%
Wind	12
Storm surge	12
Offshore	11
Tornado	4
Other	2
	100%

Source: Tropical Cyclones & Inland Flooding (2001), NOAA.



● Hurricane deaths in the U.S. have **decreased** significantly over the past **100+ years**, due to better warnings, but damage costs have **risen**, due to more people living and recreating along coastal areas.

● **Lethal to Hurricanes:** **land** (greater roughness and friction, and reduced source of **deep, warm water** for latent heat release), **colder water** (greatly slows evaporation rates), and **strong westerlies** (increased wind shear).