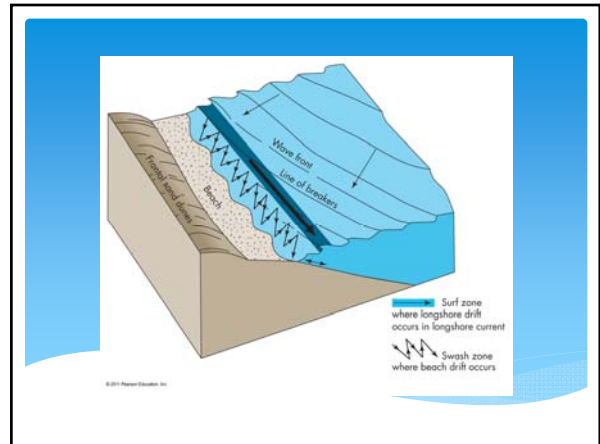
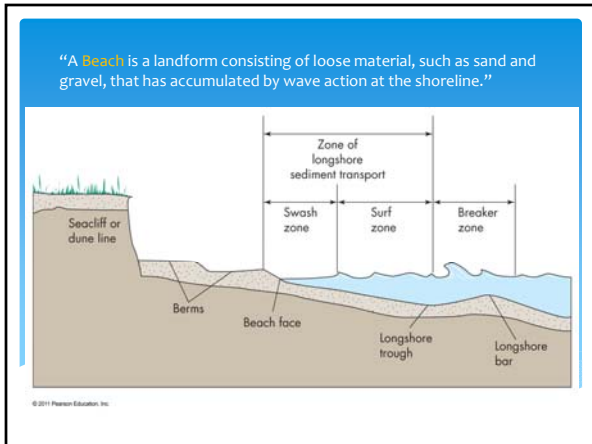
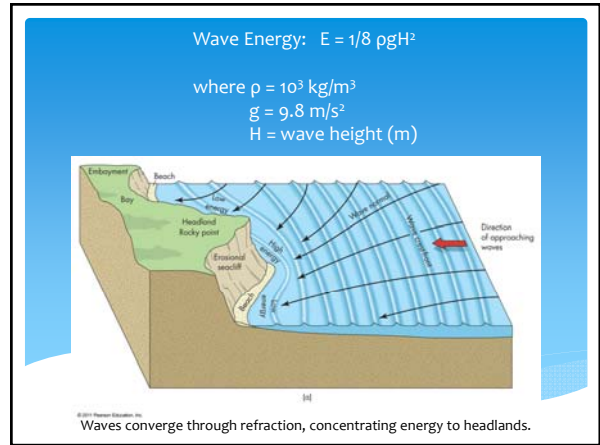
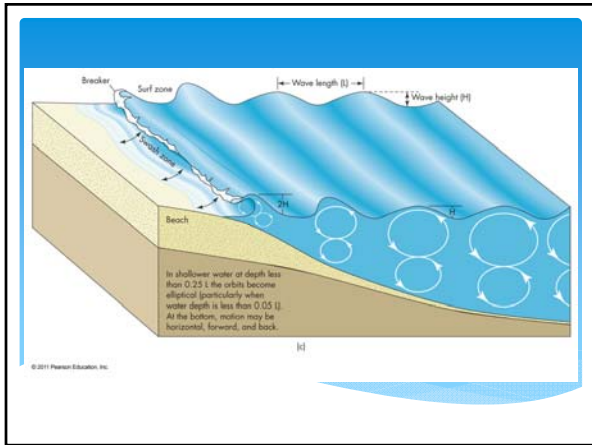
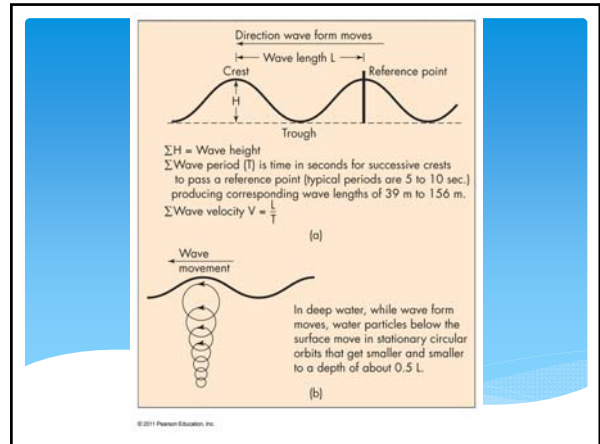


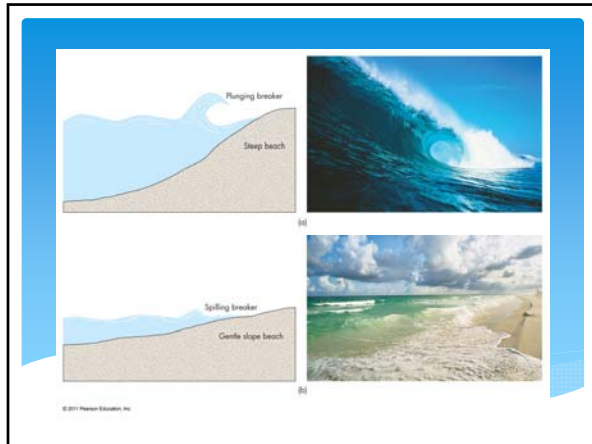
# Environmental Geology

## Chapter 10

### Coastal Hazards: Coastal Erosion and Hurricanes

Fall 2015





The **beach budget** is controlled by the inputs and outflows of material to a beach. Beaches build if the beach budget is positive; they erode if the budget is negative.

Changes to the budget can happen over time, allowing for changes in the overall budget. Sea level rise and a warming ocean lead to greater erosion.

Submarine canyon  
Coastal erosion (-) Presently observed  
Rock shoreline (narrow beach)

Beach  
 S<sub>L</sub> longshore transport (+) | - if adds sand to coastal environment  
 S<sub>E</sub> sea cliff erosion (-) | - if removes sand from coastal environment  
 S<sub>SC</sub> submarine canyon (-)  
 S<sub>R</sub> river (-)  
 S<sub>D</sub> sand dunes (-) | - if removes sand from coastal environment

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Erosion rates vary from <6 in./year to >2 m/year.

Sea cliff  
Wave-cut notch  
Sand, pebbles, and boulders  
Beach face  
Wave-cut platform (bedrock)

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### Coastal Hazards and Engineering Structures

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Seawalls

### Coastal Hazards and Engineering Structures

Wave front  
Longshore dike  
Sandy beach

D = Deposition, wide beach  
E = Erosion, narrow beach

Beach grows, barrier to longshore dike, constructed of large rock blocks or other materials

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Groins

### Coastal Hazards and Engineering Structures

Immediately following construction  
Beach  
Wave front  
Lid is direction of littoral dike

Several years after construction  
Deposition  
Erosion  
Attached breakwater (ex., Santa Barbara, California)

Immediately following construction  
Beach  
Lid

Several years after construction  
Deposition  
Erosion  
Detached breakwater (ex., Santa Monica, California)

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Breakwaters

### Coastal Hazards and Engineering Structures

Jetties  
(ex., Santa Cruz, California)

Jetties

### Coastal Hazards and Soft Stabilization

Beach Nourishment

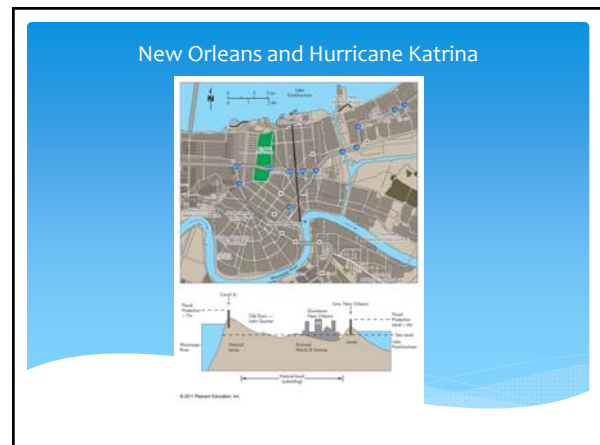
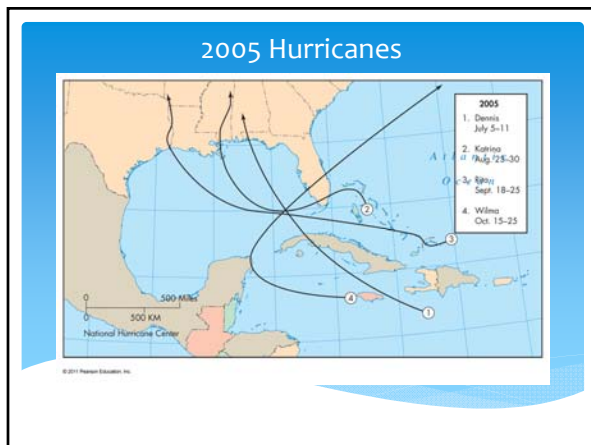
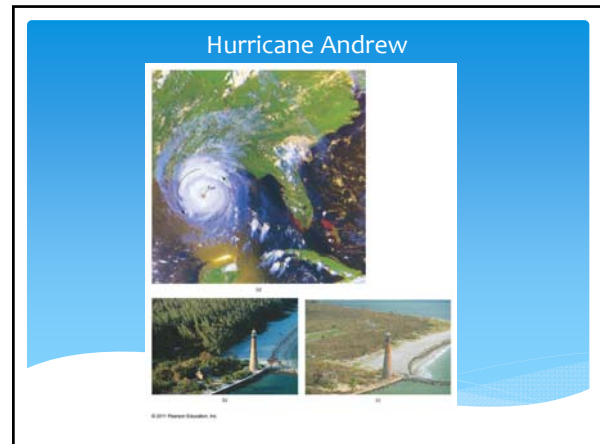
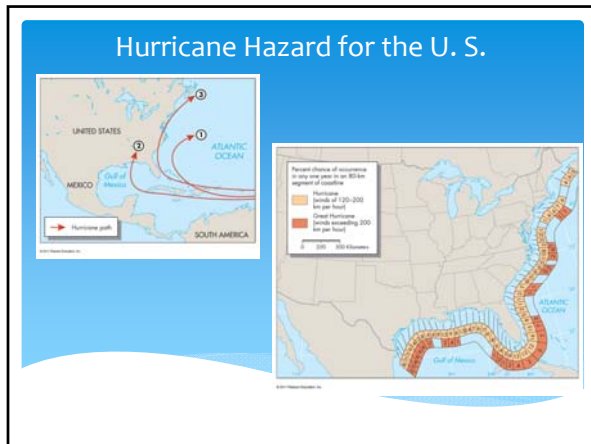
Ocean City, Maryland  
Jetties create erosion down-drift.

A **hurricane** is a tropical cyclone characterized by circulating winds over 100 km/hr generated over an area about 160 km in diameter.

Hurricanes begin as tropical disturbances that under the right conditions will gain energy from evaporating warm water (latent heat). If the wind speeds increase to at least 39 mph the system becomes a named tropical storm. Tropical cyclones with winds over 73 mph are hurricanes.

### Hurricane Intensity The Saffir-Simpson Scale

Category	Wind Speed (mph)	Wind Speed (km/h)	Storm Surge (ft)	Storm Surge (m)	Damage
1	74-95	118-153	4-6	1.2-1.8	Minor damage to buildings. Some trees and power lines may be down. Beach erosion and some coastal flooding.
2	96-110	154-177	6-8	1.8-2.4	Major damage to buildings. Many trees and power lines down. Beach erosion and coastal flooding.
3	111-129	178-207	8-12	2.4-3.7	Extensive damage to buildings. Many trees and power lines down. Beach erosion and coastal flooding.
4	130-155	208-249	12-20	3.7-6.1	Severe damage to buildings. Many trees and power lines down. Beach erosion and coastal flooding.
5	156-200	250-322	20-30	6.1-9.1	Catastrophic damage to buildings. Many trees and power lines down. Beach erosion and coastal flooding.



### New Orleans and Hurricane Katrina

Why was Katrina so bad?

- ❖ There was no fall back flood protection (system had no redundancy).
- ❖ Katrina exceeded the design criteria of the structures.
- ❖ Regional subsidence was greater than appreciated; flood protection not adjusted to account for subsidence.
- ❖ Flood control plan not adjusted to new realities.
- ❖ Greatest flooding occurred in certain areas – led to more deaths amongst poor and elderly.
- ❖ Loss of protection of coastal marshes due to human interference with the natural depositional systems.

Parts of the system have been repaired and improved since 2005.

### Adjustments to Coastal Hazards

Coastal Hazards can be adjusted to via

1. Stabilization (hard or soft); \$\$\$ and efficacy is limited
2. Land use changes – better approach but difficult to implement; E-zones or erosion hazard zones
3. Insurance – becoming more difficult to acquire in coastal areas

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