The Coast: Beaches and Shoreline Processes
Trujillo & Thurman, Chapter 10

Chapter Objectives
- Recognize the various landforms characteristic of beaches and coastal regions.
- Identify seasonal changes that beaches experience.
- Discuss how longshore currents are created and what longshore drift is.
- Note the origin of sediment for beaches and how the coastline responds to variations in supply.
- Describe how coastal features are formed by wave erosion and deposition.

Chapter Objectives (continued)
- Understand local changes that occur in coastline elevation and explain observed trends in the relative position of sea level.
- Explain how climate change can affect the nature of the coastline.
- Recognize barrier island features and describe how barrier islands are formed and evolve.
- Identify the types of hard stabilization and discuss the effects they have on shorelines.

Overview
- Coastal region constantly changes
- Primarily due to waves
  - Erosion
  - Deposition
- Many people live in coastal regions
  - 80% of people in U.S. live within easy access of coast

Coastal regions
- Coast and coastline
- Beach
- Shore, foreshore, backshore
- Nearshore, offshore
Beach
Wave-worked sediments
Wave-cut bench
Recreational beach
Berm
Beach face
Longshore bars
Longshore trough

Composition of beaches
- Locally available material
- May be coarse or fine
  - Boulders from local cliffs
  - Sand from rivers
  - Mud from rivers
- Significant biologic material at tropical beaches
  - Example, Coral reef material

Sand movement along beach
- Perpendicular to shoreline (toward and away)
  - Swash and backwash
- Parallel to shoreline (up-coast or down-coast)
  - Longshore current

Swash and backwash
- Swash
  - After wave breaks, uprush of water (swash) on beach
  - Sediment moved toward land
- Backwash
  - Water returns to ocean
  - Sediment moved away from shore
- Light wave activity
  - Swash dominates
  - Sediment moved toward shore
  - Wider beach
- Fair weather
- Summertime beach
Swash and backwash
- Heavy wave activity
  - Backwash dominates
  - Sediment moved away from shore
  - Narrower beach
- Sand forms offshore sand bars
- Stormy weather
- Wintertime beach

Longshore current
- Wave refraction causes water and sand to move parallel to shore
- Zigzag motion in surf zone
- Longshore current
- Longshore transport

Erosional shorelines
- Well-developed cliffs
- Recent tectonic activity
- Headlands
- Wave-cut cliff with sea cave
- Sea arches
- Sea stacks
- Marine terrace
- Wave erosion increases with
  - More shore exposed to open ocean
  - Smaller tidal range
  - Weaker bedrock

Longshore transport
- Millions of tons of sediment moved yearly
- Direction of transport changes due to wave approach
- In general, sediment transported southward along Atlantic and Pacific coasts of U.S.
**Depositional shorelines**

- Primarily deposited by longshore drift
- Beach
- Spit
- Bay barrier
- Tombolo
- Barrier island
- Delta
- Beach compartment

**Barrier islands**

- Long, narrow offshore deposits parallel to shore
- Most developed due to rise of sea level about 18,000 years ago
- Common East and Gulf coasts of U.S.
- Protect mainland from high wave activity

**Deltas**

- River sediments reworked by ocean processes: waves, tides
- Distributaries carry sediment to ocean
**Beach compartments**
- Rivers supply sediment
- Beach
- Offshore submarine canyons “drain” sediments from beach
- Beach starvation

**Emerging shorelines**
- Shorelines above current sea level
- Marine terraces

**Submerging shorelines**
- Shoreline below current sea level
- Drowned beaches
- Submerged dune topography
- Drowned river valleys (estuaries)

**Changing sea level**
- Local tectonic processes
  - Example, Pacific Coast of U.S. and active plate margin
  - Isostatic adjustments
  - Ice-loading
- Global (eustatic) changes in sea level
  - Changes in seafloor spreading rates
  - Lake buildup or destruction
  - Ice volume changes

**Eustatic changes in sea level**
- Ice build up (glaciation)
- Ice melting (deglaciation)
- Thermal contraction and expansion of seawater
- About 120 m (400 ft) change in sea level
Global warming and changing sea level

- About 0.6°C (1.1°F) warmer over last 130 years
- Sea level rose 10-15 cm (4-10 in) over past 100 years
- If global warming continues, higher sea level

Atlantic coast

- Most coasts open to wave attack
- Barrier islands common
- Varied bedrock from resistant rocks to non-resistant sedimentary rocks
- Sea level rising about 0.3 m (1 ft) per century
- Drowned river valleys common
- Average erosion 0.8 m (2.6 ft) per year

U.S. coasts

- Erosion or deposition dominates
- Type of bedrock
- Tidal range and wave exposure
- Active tectonics
- Eustatic changes in sea level

Atlantic coast

- Barrier islands
- Drowned river valleys
**Gulf coast**
- Low tidal range
- Generally low wave energy
- Tectonic subsidence
- Mississippi delta dominates
  - Locally sea level rises due to compaction of delta sediments
- Average rate of erosion 1.8 m (6 ft) per year

**Pacific coast**
- Tectonically rising
- Bedrock typically non-resistant sedimentary rocks
- Open exposure to high energy waves
- Average rate of erosion 0.005 m (0.016 ft) per year

**Hard stabilization**
- Structures built to decrease coastal erosion and interfere with sand movement
- Often results in unwanted outcomes
  - Some structures may increase wave erosion
- Groins and groin fields
- Jetties
- Breakwaters
- Seawalls

**Groins and groin fields**

**Jetties**

**Breakwaters**
Seawalls

Alternatives to hard stabilization

- Construction restrictions
  - Limit building near shorelines
  - National Flood Insurance Program encouraged construction
- Beach replenishment
  - Sand added to beach/longshore current

Alternatives to hard stabilization

- Relocation
  - Move structures rather than protect them in areas of erosion

End of CHAPTER 10
Beaches and Shoreline Processes