Chapter 12: Waves pg. 337-352

Introduction to Coastal Hazards

- Influenced by plate tectonics
- Atlantic Coast of CAN and US is located on a tectonically passive margin (wide continental shelves and extensive sandy beaches and barrier islands)
- Pacific coast of CAN and the US located on tectonically active margin (coasts with sea cliffs and rock shorelines)
- Coastal topography is strongly influenced by geology – type and structure of the rock at the shorelines
- shorelines affected by climate, plants and animals
- Main coastal hazards:
    - Strong coastal currents, including rip currents generated in the surf zone and tidal currents in narrow bays and channels
    - Coastal erosion
    - Sea-level rise
    - Storm surges from tropical and extratropical cyclones
    - Tsunamis

Coastal Processes

- Waves
    - Generated by wind, transfers energy to water, producing waves, then waves expend their energy at the shoreline
    - Size depends on:
        - Velocity of wind
        - Duration of wind
        - Distance wind blows across the water (fetch)
    - As waves move away from their source, they become organized into groups or sets of similar size and shape
    - Rogue waves
    - 3 parameters describe the size and movement of the wave
        - wave height: difference in hiehgt between the trough and the crest of the wave
        - wavelength: distance between successive wave crests
        - wave period: time in seconds for successive waves to pass a reference point
    - at about ½ their wavelength, waves begin to feel the bottom causing the circular orbits to become ellipses
    - swell: wave sets generated by storms far out at sea
        - by knowing the velocity and height of the waves generated by a distant storm, we can estimate when the waves will strike shore and how erosive they will be
    - wave crest becomes unstable when the water depth is about 1.3x the wave hiehgt
- Variations along a Coastline
    - Caused by irregularities in near-shore bathymetry and the shape of the coastline
    - Headlands: small rocky peninsulas

  - Refract: bending of wave
  - Effects of Wave Refraction
    - Shorelines tends to become straightened
  - Breaking Waves: plunge (steep beaches and can be erosive) or surge (develop on wide, gently sloping, sandy beaches and are less erosive than plunging breakers)
  - Tidal bores: steep fronts, several metres high, and surge forward like broken waves
- Beach Form and Processes
  - Beach: loose material that has accumulated by wave action at the shoreline
  - The Beach Onshore
    - Sea cliff: landward boundary of the beach can be a cliff along a seashore
    - Bluff: ^^ along lakeshore
    - Coastal sand dunes form by deposition of wind-blown beach sand
    - Two zones:
      - Berm: flat or slopes gently landward
      - Beach face: slopes seaward, located within the swash zone
  - The Beach Offshore:
    - Surf zone: just seaward of the swash zone and is the place where waves move turbulently toward the shore after they break
    - Breaker zone: incoming waves peak and break
      - Longshore bar: low ridge consisting of sand or gravel
      - Longshore trough: form by wave and current action landward of the longshore bar
- Sand Transport
  - Sand not static
  - littoral transport: sand carried parallel to the shore in the swash and surf zones
    - beach drift: repeated shoreward and seaward movement of sand in the swash zone produces sinuous or zigzag transport path
    - longshore drift: transport of the sediment by currents that flow parallel to the shoreline (longshore currents)
- Landforms Produced by Littoral Drift
  - Spits: narrow and low, finger-like ridges of sand or gravel that are attached to the coast and extend out into the sea or lake
  - Tombolos: similar to spits except they are connected at both ends to the shore
  - barrier islands: long and relatively narrow islands that lie offshore of a coast and are parallel to it

Sea-Level Change

- constantly changing due to tidal fluctuations produced by the gravitational attraction of the moon and the sun
- changes in wind speed and atmospheric pressure
- relative sea level: controlled by the vertical movement of both the land and sea water
- Eustatic Sea-Level Change: global changes in sea level when the amount of water in the world's oceans increase or decrease or when theres a change in the shape of ocean basins
  - Due to platemovements
  - Climate

        - Average air temp: as sea water warms it expands and as it cools it contracts (thermal expansion)
        - Atmospheric temp: control the amount of snow and glacier ice on land (glaciers to melt increasing water in the oceans)
- Isostatic Sea-Level Change: local and regional processes also affect relative sea level, general equilibrium of the forces tending to elevate or depress Earth's crust
    - Increase or decrease in the weight of ice or water on the crust or by change in the thickness of the lithosphere
    - Glacio-isostatic uplift
    - Hydro-isostatic uplift
- Tectonic and Other Effects
    - Sudsidence of deltas

Coastal Hazards
- Coastal communities threatened by coastal erosion and sea-level rise
- Rip Currents: carry large amounts of water directly away from the shore
- Coastal Erosion: shorelines retreat
- Beach Erosion: sediment budget, both gain and lose material
    - If losses are greater than gains, beach erodes
    - Losses are less than gains, beach grows by accretion of sand
- Cliff Erosion: moving shoreline landward
- Sea-level Rise: entire islands disappear

Links Between Coastal Processes and Other Natural Hazards
- Intense precipitation and storm surges
- Landslides
- Climate conditions

Natural Service Functions of Coastal Processes
- Ecological health and aestethic value of coastal zone
- Deposits of diamds and gold