

GLG 101 – CHAPTER 10 - COASTAL EROSION

- The height of a wave is the distance from the top (crest), or highest point of the wave to the bottom (trough) or lowest point. The distance between successive wave crests (or troughs) is called the wavelength. The wave height and wavelength are controlled by wind speed (wind blowing over water produces waves), length of time the wind has been blowing, and the area over which the wind is blowing over the water.
- Motion of water particles in waves is up and down in a circular (orbital) fashion. The wave/disturbance moves forward, but the water itself does not.
- The place where waves break is known as the “surf zone”, and is the only place where significant forward motion of water is actually occurring.
- Beach erosion/wave erosion is produced by abrasion and by the impact pressure of waves breaking against the beach or headlands. *Plunging breakers* are the curled-over type of waves favored by surfers who want to ride the *pipeline* in Hawaii, and *rolling breakers* are the more low-key type that just break apart into white foam without the overturned lip.
- Most waves hit the shore at an angle and bend around headlands in a process known as wave “refraction”. This produces a longshore current, which moves sand down along the beaches. Eroding in one area and then redepositing in another. *Beach drift* and *longshore drift* combine to move sand along the coastlines (collectively known as *littoral transport*).
- So long as there is a constant supply of sediment from rivers, no net erosion has to occur. When sand resupply is blocked by groins, jetties, etc. (or is removed from a channel by dredging), enhanced beach erosion can occur downstream from these structures, while increased deposition occurs upstream of these features.
- Sand tends to be pushed onto the beaches by mild summer waves and be eroded into offshore bars during stronger winter storms. Offshore sand bars can form and block bays (baymouth bars) or continue as spits beyond the end of headlands.
- When offshore sea stacks or breakwaters decrease wave action, sand bars can build up and connect these structures to land via a sand peninsula known as a *tombolo*.
- *Beach nourishment* is an alternative to construction of hard structures, such as groins, jetties and breakwaters, and involves simply putting more (and hopefully slightly coarser) sand onto a beach to maintain a positive “sand budget” from year to year.
- Sea level rises during warm climates when glaciers are melting away, and drops during ice ages as water is taken from the oceans and supplies the growing glaciers. Increased coastal erosion occurs during ice ages as water can flow down farther to reach the lowered sea level.
- Tides are the oscillations in local sea level produced by the gravitational pull of the moon on the oceans. As the Earth spins, the “overhead” position of the moon sweeps across all latitudes.

When the moon is overhead, gravity from it is a maximum, and the water is pulled upward to form high tide. This also happens on the opposite side of the earth at the same time as water is pulled away from the “sides” of the planet (where low tide is occurring). Hence, there are two high tides and two low tides in every 24-hour period. When the moon is closest to Earth, and the moon and sun are lined up together (either new or full moon), then tides are maximum (spring tides). When the sun and moon are at 90 degrees to one another with respect to the earth (first and last quarter moon), then tides are at a minimum (neap tides).

- **Barrier islands** are long narrow islands (typically equivalent to big sand bars) separated from the main coastline by a body of water (e.g., a bay). The Outer Banks of North Carolina (of Wright Brothers at Kitty Hawk fame) are a prime example. Such islands are dynamic places, shifting back and forth, with inlets forming and reforming, under the influence of large storms. People occupy these naturally changing landscapes at their peril, as structures are not as naturally mobile as the sand bars on which they’ve been built
- **Tropical Cyclones**
 - Typhoons in Pacific
 - Hurricanes in Atlantic
 - Form where thunderstorms from over land move out over warm ocean waters (in tropical latitudes) and gather energy from the warmth
 - Counterclockwise rotation; low pressure system
 - Hazards from these storms include:
 - ♣ High winds
 - ♣ Flooding, due to intense rainfall over an extended period of hours to a day
 - ♣ Storm surge
 - Individual typhoons have hit Bangladesh and caused 100,000 to 300,000 deaths!
 - Saffir-Simpson scale of sustained wind intensity:
 - ♣ Category 1 – 119-153 kph (74-95 mph)
 - ♣ Category 2 – 154-177 kph (96-110 mph)
 - ♣ Category 3 – 178-209 kph (111-130 mph)
 - ♣ Category 4 – 210-249 kph (131-155 mph)
 - ♣ Category 5 – >249 kph (>155 mph)
- Responses to Tropical Cyclones and Beach Erosion
 - Do nothing and bear the occasional losses
 - Evacuation, relocation, and change in coastal land use

- Beach nourishment
 - Shoreline stabilization (groins, jetties, breakwaters) and raising buildings on stilts
- Once humans become involved in altering the coastal zone, they must stay involved, or reap the consequences (down-current erosion, channel filling, structure damage and destruction) of the changes such involvement produces