Coastal Processes and Hazards

About 75% of the US population lives in coastal areas. Impacts from coastal hazards can be substantial. The source of the hazards includes several "non-geologic" processes such as:

- Tropical cyclones: - high winds (100+ km/hr), - flooding from intense precipitation, - storm surges

- Tidal floods: storm surges coinciding with tidal peaks

- Tsunami’s: seismic sea waves
The geologic hazards vary according to the continental margins

There are two general ocean margins – **passive and active margins** – both are related to plate tectonics.
Components of the active margin

Active Margins

- Trench
- Accretionary wedge
- Subducting oceanic lithosphere
- Asthenosphere
All coasts are divided into natural compartments called **littoral cells**. Each cell contains a complete cycle of sedimentation including sources, transport paths, and sinks.

![Image](www.surfrider.org/structures/images/canyons.jpg)
The Littoral Cell

The presence of sand on any particular beach depends on the transport of sand within the cell. When structures such as dams or harbors interfere with sand transport, downcoast beaches will erode. Therefore, the littoral cell and its budget of sediment are essential planning tools for regional and coastal management.
Beaches

Summer versus winter beaches
Coastal Processes and Hazards

Coastal hazards that arise along the different margins include:

- **Erosion** – due to wave action and fluctuating sea levels
- **Deposition** – from littoral transport
Perceptions and adjustment to hazards

More and more the question is becoming:

*do we continue to subsidize development in risky coastal areas?*

From 1978 to 1982, $43 million dollars in federal flood insurance was paid in damage claims to barrier-island residents, which far exceeded the premiums they paid.

It is becoming increasingly obvious that the most sensible thing to do with many such structures is to abandon the costly and ultimately doomed efforts to protect or maintain them, and simply leave these areas in their dynamic, natural, rapidly changing state, most often as underdeveloped recreation areas.
Perceptions and adjustments to hazards

From a philosophical perspective:

1. Coastal erosion is a natural process rather than a natural hazard; erosion problems occur when people build structures in the coastal zone.

2. Any shoreline construction causes change.

3. Engineering structures designed to protect a beach may eventually destroy it.
Coastal Processes and Hazards

From a philosophical perspective:

4. Stabilization of the coastal zone through engineering structures protects the property of relatively few people at a larger general expense to the public.

5. Once constructed, shoreline engineering structures produce a trend in coastal development that is difficult if not impossible to reverse.
End
Erosion

- Sea level has risen 15 – 20 cm during the last century.

www.wildwildweather.com/forecastblog/wp-conte
Changing sea levels over time produce **emerging shorelines**. Tectonic uplift also causes land to slowly emerging from the sea.
Changing sea levels over time produce **submergent** shorelines.
Erosion

Effects of waves

Waves are a powerful force. The net effect is to straighten out shorelines and transport large volumes of sediment.
Erosion

Effects of waves

Waves are a powerful force. The net effect is to straighten out shorelines and transport large volumes of sediment.

Wave erosion – force is concentrated on headlands, resulting in excessive erosion. Called wave refraction and results from wave “drag” on ocean floor.
Erosion

Effects of waves

Waves are a powerful force. Can cause severe erosion problems along coastal areas.
Erosional Landforms – winter, 1989
Erosional Landforms – February, 1990
Erosional Landforms – February, 1991
Erosional Landforms – February, 1993
Erosion

El Nino conditions produce more extreme wave conditions

Warmer than normal waters produce warm air masses that hold lots of rain and produce severe storms and waves.
Erosion

El Nino conditions produce more extreme wave conditions

Normal wind and water motion
Erosion

El Nino conditions produce more extreme wave conditions

El Nino wind and water motion
Deposition

Effects of waves

Waves are a powerful force. The net effect is to straighten out shorelines and transport large volumes of sediment.

Wave deposition – waves spread out here, have less energy. **Longshore drift** moves sand as a sheet along the coastline.
Deposition

Sand transportation – is a natural process but has also been affected by humans.

Groins – encourage deposition in desired locale.
Deposition

Sand transportation – is a natural process but has also been affected by humans.

**Jetties** – designed to keep river channels from filling in and relocating due to sand deposition.
Deposition

Sand transportation – is a natural process but has also been affected by humans.

breakwaters – designed to protect and encourage harbor development.
Deposition

Sand transportation – is a natural process but has also been affected by humans.

Man-made structures in action.
Links