HAZARDS AND RISKS ALONG COASTS (34)

I Main topics
- A Hazard recognition
- B Characterization of hazards
- C Risk evaluation
- D Risk Assessment

II Hazard recognition
- A Hazards peculiar to coasts
  - 1 Coastal erosion
  - 2 Coastal deposition
  - 3 Hurricanes
  - 4 Tsunami
- B Hazards accentuated at some coasts
  - 1 Sea cliff retreat/sea cliff failure
  - 2 Wind damage
  - 3 Quick clays (where young sediments are uplifted)
  - 4 Seismic shaking (because of proximity to subduction zones)

III Characterization of hazards and processes

<u>Dynamic competition between waves and sediment supply</u>

- A Waves
  - 1 Underwater nearshore topography
  - 2 Continental shelf topography
  - 3 Changes in relative sea level
  - 4 Wave statistics
    - a Direction
    - b Period
    - c Height
    - d Pressure and Forces (6 tons/ft^2 measured = 0.7 MPa)

B Sediment

1 Sources

a Beach steepness
b Composition and grain size (90%+ are sand); coarse⇒steep
c Human intervention

2 Sinks

a Submarine canyons
b Human intervention

3 Sand motion perpendicular to shore

a Flat waves (H/L < 0.025): sand moves onshore
b Steep waves (H/L < 0.025): sand moves offshore

4 Longshore drift rate (rate of sand movement in surf zone)

a Longshore currents set up by oblique approach of waves
b Swash + Backwash ⇒ longshore drift
c Example: 1,000,000 m^3/yr at Oxnard, So. Cal.)

5 Biology (e.g., kelp)

6 Geologic History
a What has happened can happen
b Helps to pin down the high-energy, low frequency events
c Paleo-hurricane studies now underway

B Hazards and processes accentuated at some coasts
1 Sea cliff failure: Landslides
2 Wind damage: Meterology
3 Seismic shaking (liquefaction): Distribution of faults and Quaternary deposits

IV Risk evaluation
A Uncertainty regarding high-energy, low frequency events
B We commonly don't design for these (too expensive)
C These represent the tails of probability distributions

V Risk Assessment: Is the level of risk acceptable

- A Common answer: yes (in part because infrequent events are ignored)
- B Coastal engineering structures for which risks can be assessed
  - 1 Harbors
  - 2 Buildings
  - 3 Piers
  - 4 Pipelines (e.g., oil, sewage) and cables
  - 5 Floating structures (e.g., drill rigs)
  - 6 Seawalls, jetties, breakwaters, groins, rip rap
- C Engineering solutions
  - 1 Location and orientation
    - a Don't locate structures where wave energy is focused
    - b Don't orient structures parallel to prevailing waves
    - c Jetty spacing
      - i Natural streams commonly near equilibrium in terms of channel with and cross section dimensions
      - ii Tidal prism volume/cross section of entrance
      - iii Tidal prism volume = average volume that flows in and out in a tidal cycle. Volume between higher high water and lower low water.
      - iv Spacing too high → sedimentation
      - v Spacing too low → erosion
  - 2 Ability to reflect or absorb energy
    - a Shape
      - i Uniform shapes not good
      - ii Stepped shapes are good for breakwaters
    - b Armor
      - i Dense
      - ii Permeable
      - iii Not rectangular blocks
      - iv Problem: Commonly lead to beach loss
  - 3 Dredging and replenishment of sand
  - 4 Build with nature as much as possible
- D Insurance