MAR 110 Lecture #1
Introduction to Oceans Hazards

SECTION I – Volcano, Earthquake, and Tsunami Hazards

Figure 1.1  Ocean Basin Rim Hazards - Earthquakes
Earthquake-Induced Oil Storage Tank Conflagration – Valdez, Alaska. (NG)

Figure 1.2  Ocean Basin Rim Hazards - Volcanoes
Volcanoes by the sea do explode creating ash that can bury a city and its inhabitants - Pompei, Italy and deadly tsunamis that can raise havoc many miles away (NG)
Figure 1.3 Earthquake Distribution

(Top) The location of shallow earthquakes (less than 100km deep); note how they silhouette both ocean spreading ridges and convergent zones. (Bottom) The locations of deep earthquakes are usually associated with plate subduction. (e.g., circled Sumatra earthquake – 26 December 2004)
A tsunami wave generated by an earthquake in the Azores in 750 AD pummeled Lisbon, Portugal.

Figure 1.5 Lisbon Earthquake/Tsunami

The 26 December 2004 Sumatra tsunami: It’s origin and configuration in the Indian Ocean after 2 hr, 3.5 hr and about 10 hr. (NG Apr05)
Figure 1.6 Ancient Continental Configuration

Pangaea: the continental configuration 200-300 million years ago showing how most of the present day continents were physically connected to each other into two super continents called *Laurasia* and *Gondwanaland*. Note the location of the even older (i.e., paleo-) equator at that time as well and its relation to coal beds, which along with other geologic structures were used by scientists to determine how the continents were connected. (ITO)
Figure 1.7 Continental Drift
A time series showing the configuration and movement (arrows) of the continents at (top) 200 million years ago; (middle) 65 million years ago; and (bottom) today. (?)
SECTION II – Hurricane Surge, Storm & Rogue Wave Hazards

Figure 1.8 Plate Tectonics Dynamics
A schematic of the major plate tectonic features in the upper 450km of the Earth. Convection in the Asthenosphere, under the ocean ridge, causes the lithospheric plates to pull apart in the divergent zone, move in opposite directions across the ocean basin, collide with the adjacent plate in a convergent zone, and subduct to great depth. The subducting lithosphere melts at depth and rises as magma to form a volcanic island arc. (ItO)

Figure 1.9 Hurricane Carol Visits Narragansett Bay 1954
(left) Hurricanes form in the eastern tropical Atlantic and (right) can move rapidly northward to surprise New England. (projo)
Figure 1.10 The Great New England Hurricane - 1938
The track of the September 1938 hurricane.
Multiple ship reports allowed meteorologists to reconstruct the trajectory after it struck Long Island and New England without warning on 21 September. (projo)

Figure 1.11 Hurricane Surge Destruction
(above) The storm surge and waves of the Hurricane of 1938 lifted the cottages with people in them off their foundations in Watch Hill, RI (bottom) and swept them away. (sst)
Figure 1.12 Storm Waves
Waves generated by winds at sea can travel long distances to cause great coastal destruction. (?)

Figure 1.13 Rogue Waves
(left) The Great Wave by Katsushika Hokusai (1830) was “inspired” by serious tsunami impacts on Tokyo Bay; with geography that amplifies tsunami waves more than would usually be expected. (right) Unexpected waves with heights exceeding 100ft – “rogue waves” can imperil ships (?)
SECTION III - Climate Change Hazards

Short-Term Changes – El Nino

Figure 1.14 El Nino-Related Destruction (NG Nov76)

Figure 1.15 El Nino-Related Destruction
(left above) East to west winds normally trap the warmer surface waters of the tropical pacific to the west. (left below) However, the winds change every 3-7 years allowing the warm water to ‘race’ to the eastern side of the ocean – changing the climatic conditions when they do. (right) In the case of Peru, storms are more frequent, more rain falls causing flooding and economic hardship.
Long-Term Changes

Figure 1.16 Long-Term Climate Change
(above) Glacial cycles with their associated major temperature changes occur over time scales ranging from 10,000 to 100,000 years. (below) Some scientists believe that glacial cover was extreme at a time 100 millions of years ago.
On April 12, 1912 the Titanic hit an iceberg and sank in the North Atlantic Ocean taking most of the crew and passengers aboard with it. That year had been one of an unusually large number of icebergs traveling much farther south than they had in previous years. (?)
Figure 1.20 Tipping Point?

Figure 1.21 Greenhouse Gas Buildup
CO₂ concentration measurements on Mona Laua, HI between 1950 and 1995 showing a general increase. The annual CO₂ uptake by continental vegetation is reflected by the saw tooth form. (UWaC)