EOSC 314: The Ocean Environment

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Course overview

This course is presented in 6 Modules.

Module A: The Blue Planet (Introduction to Oceanography)

How did the Earth, its oceans, and atmosphere come to be? How are Earth's oceans unique and what does the ocean look like beneath its surface? What have oceanographers learned about this largest and most unique feature of our planet Earth? Why is it important to study the oceans?

The ocean floor is not a flat, featureless expanse, as it was once believed to be. With the invention of modern tools and techniques, scientists have been able to map and study the various features of the ocean floor. The ocean floor is found to be replete with a wide variety of features – long mountain chains, deep depressions, volcanic mounts, hills, channels, and plains – similar in appearance to those features on land. By studying these underwater features, scientists have been able to develop theories to explain the formation of the world's oceans and continents.

Module B: The World's Oceans

Seawater consists of a solution of various salts and gases in water. The amounts of these dissolved salts and gases vary within the ocean, but the major ions are distributed in relatively constant proportions. The geochemical cycle keeps the composition of the seawater relatively constant. The vertical and horizontal distribution of nutrients and gases reflects various biological and chemical processes occurring in the ocean. As well, the exchange of gases between the ocean and the atmosphere plays an important role in determining Earth's climate.

Sediments accumulating on the sea floor are mixtures of particles derived from land, marine organisms, precipitates from seawater, and particles of volcanic and cosmic origin. Sediments on the deep-sea floor accumulate very slowly, and their distribution can be explained by their origins and dynamics of transport, settlement, and preservation on the seafloor. Thus, sediments accumulating on the sea floor relate much about Earth's history. They provide clues to historical climate, plate motion, marine organisms, and the circulation of ocean water.

Module C: Waves and Tides

Waves, whether generated by wind, earthquakes, or cosmic forces, share common characteristics in the ocean. The characteristics of ocean waves are studied, from their generation to their eventual transition as they reach shore. The concept of waves is extended to the propagation of tides, tsunami, and storm surges.

Module D: Surface and Deep Ocean Circulation

Heat from the sun drives the circulation of the atmosphere, which in turn is responsible for most of the large-scale features of ocean circulation. There are two types of large scale flows in the oceans: the thermohaline circulation, a deep convective flow driven by density instabilities caused by excessive cooling or evaporation of the surface water; and the wind-driven circulation seen mainly in the upper part of the ocean. The influence of the Earth's rotation may be seen in these flows, and is particularly visible in the wind-driven circulation, where strong currents such as the Gulf Stream are pushed against western boundaries. These strong boundary currents can become unstable, and shed cold or warm water eddies which last for several months and transport heat and nutrients to cold or nutrient-poor waters.

Module E: The Ocean and World Climate

El Niño is a major disruption of the equatorial Pacific climate, which occurs every 2-10 years and which causes severe changes in weather patterns around the globe. It is caused by changes in the trade winds and the resultant flow of waters in the eastern and western Pacific Ocean. El Niño conditions are easily detected in the eastern Pacific by the presence of anomalously warm surface waters and measurably higher sea levels. The continued study of oceanic and land effects owing to El Niño and feedbacks/responses to these is important in understanding short-term variation in global climate.

The carbon dioxide (CO_2) levels in the atmosphere are rising as a result of human activities. Since the Industrial Revolution (roughly the last 150 years), atmospheric CO_2 content has increased from 290 ppmv (parts per million by volume) to 370 ppmv. The main source of anthropogenic CO_2 release is the burning of oil, coal, and other fossil fuels. What will be the net effect of all of the changes that global warming will bring about? Will the ocean moderate global warming by increasing its carbon storage, and in the process absorb some of the excess anthropogenic CO_2 from the atmosphere, or will it amplify global warming by releasing more CO_2 to the atmosphere? This is currently an open question for which scientists are actively seeking an answer.

Module F: The Coastal Ocean

Coastal oceanography is the study of the interactions of waves and currents in a near-shore environment. The energy of waves is responsible for shaping the coastline, through the erosion of the shore, and for transporting and depositing the eroded sediments to form new coastal features. Change to the shoreline often creates problems for people who live on or near it, and the efforts invested in saving property are generally costly and frequently ineffective. An understanding of the interactions between the oceans and the shore will help people to cope with these powerful natural forces.

The oceanography of the British Columbia coast is portrayed as an example of a complex coastal system. The circulation of the Strait of Georgia-Juan de Fuca Strait waterway, along with the effects of the enormous input of fresh water from the Fraser River, is discussed.