



Module 1: The Ocean Environment

Websites for Further Investigation

The Effects of Temperature and Salinity on Water Density

Heat fluxes, evaporation, rain, river in flow, and freezing and melting of sea ice all influence the distribution of temperature and salinity at the ocean's surface. Changes in temperature and salinity can increase or decrease the density of water at the surface, which can lead to convection. If water from the surface sinks into the deeper ocean, it retains a distinctive relationship between temperature and salinity which helps oceanographers track the movement of deep water. In addition, temperature, salinity, and pressure are used to calculate density. The distribution of density inside the ocean is directly related to the distribution of horizontal pressure gradients and ocean currents. For all these reasons, we need to know the distribution of temperature, salinity, and density in the ocean.

- <http://www.msc.ucla.edu/oceanglobe/pdf/densitysalinity/densityintro.pdf>

Salinity: Why is the Sea Salty?

At the simplest level, salinity is the total amount of dissolved material in grams in one kilogram of sea water. Thus salinity is a dimensionless quantity. It has no units. The variability of dissolved salt is very small, and we must be very careful to define salinity in ways that are accurate and practical.

- <http://www.utdallas.edu/~pujana/oceans/why.html>

Ocean Temperature, Wind

During the daytime, land heats up much faster than water as it receives solar radiation from the Sun. The warmer air over the land then begins to expand and rise forming a thermal low. At the same time, the air over the ocean becomes a cool high because of water's slower rate of heating. Air begins to flow as soon as there is a significant difference in air temperature and pressure across the land to sea gradient. The development of this pressure gradient causes the heavier cooler air over the ocean to move toward the land and to replace the air rising in the thermal low.

- <http://oceanmotion.org/html/background/upwelling-and-downwelling.htm>

pH Balance

On the pH scale, which ranges from 0 on the acidic end to 14 on the alkaline end, a solution is neutral if its pH is 7. At pH 7, water contains equal



concentrations of H⁺ and OH⁻ ions. Substances with a pH less than 7 are acidic because they contain a higher concentration of H⁺ ions. Substances with a pH higher than 7 are alkaline, they contain a higher concentration of OH⁻ than H⁺. The pH scale is a log scale so a change of one pH unit means a tenfold change in the concentration of hydrogen ions.

- <http://www.pmel.noaa.gov/pubs/PDF/feel2899/feel2899.pdf>

Ocean Currents

Horizontal and vertical circulation system of ocean waters, produced by gravity, wind friction, and water density variation. Coriolis forces cause ocean currents to move clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere and deflect them about 45° from the wind direction.

- <http://earth.usc.edu/~stott/Catalina/Oceans.html>

Ocean Tides

Tides are the periodic rise and fall of the ocean waters. They are caused by the gravitational pulls of the Moon and (to a lesser extent) Sun, as well as the rotation of the Earth.

- <http://www.physicalgeography.net/fundamentals/8r.html>
- <http://home.hiwaay.net/~krcool/Astro/moon/moontides/>

Ocean Waves

Everything from earthquakes to ship wakes creates waves; however, the most common cause is wind. As wind passes over the water's surface, friction forces it to ripple. The strength of the wind, the distance the wind blows (fetch) and the length of the gust (duration) determine how big the ripples will become. Waves are divided into several parts. The crest is the highest point on a wave, while the trough, or valley between two waves, is the lowest point. Wavelength is the horizontal distance, either between the crests or troughs of two consecutive waves. Wave height is a vertical distance between a wave's crest and the next trough. Wave period measures the size of the wave in time. A wave period can be measured by picking a stationary point and counting the seconds it takes for two consecutive crests or troughs to pass it.

- <http://www.seafriends.org.nz/oceano/waves.htm>
- <http://www.buzzle.com/articles/oceanic-waves.html>



The "Water Planet"

Water is the most abundant substance on the Earth's surface, and its properties have a profound effect on the ocean's chemical, physical, and biological makeup. To understand the behavior of the ocean we need to understand sea water.

- <http://www.mos.org/oceans/planet/index.html>
- <http://www.leonardodicaprio.org/files/videos/waterplanet.html?q=whatsimportant/watermovie.htm>
- <http://www.fas.org/spp/military/docops/afwa/ocean-U1.htm>