

Unit 10: Oceans and Climate

Lecture 1

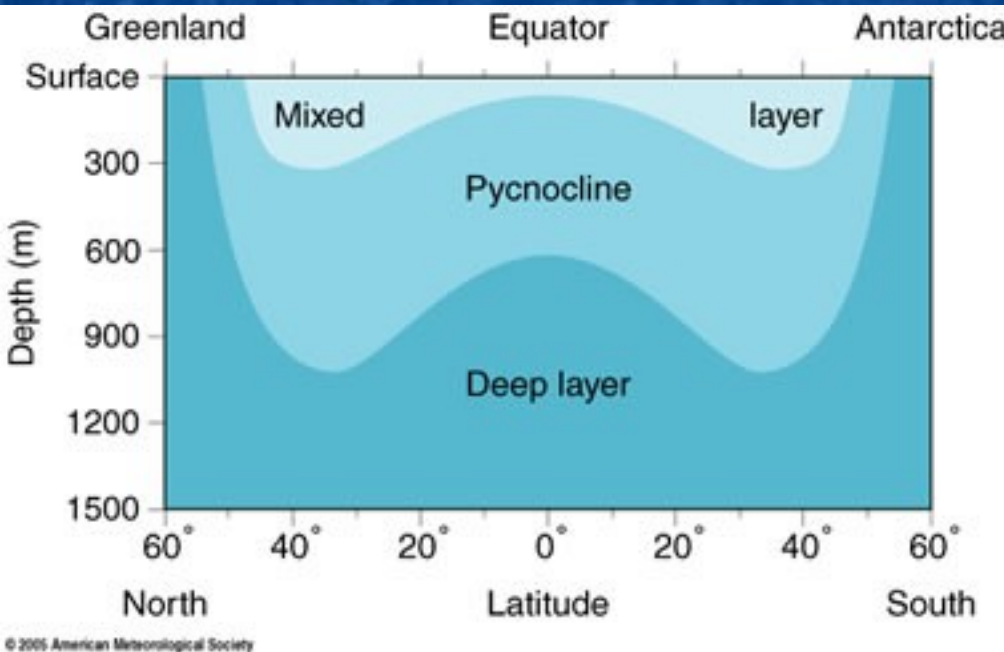
Objectives:

E4.2A - Describe the major causes for the ocean's surface and deep water currents, including the prevailing winds, the Coriolis effect, unequal heating of the Earth, changes in water temperature and salinity in high latitudes, and basin shape.

E4.2d - Identify factors affecting seawater density and salinity and describe how density affects oceanic layering and currents.

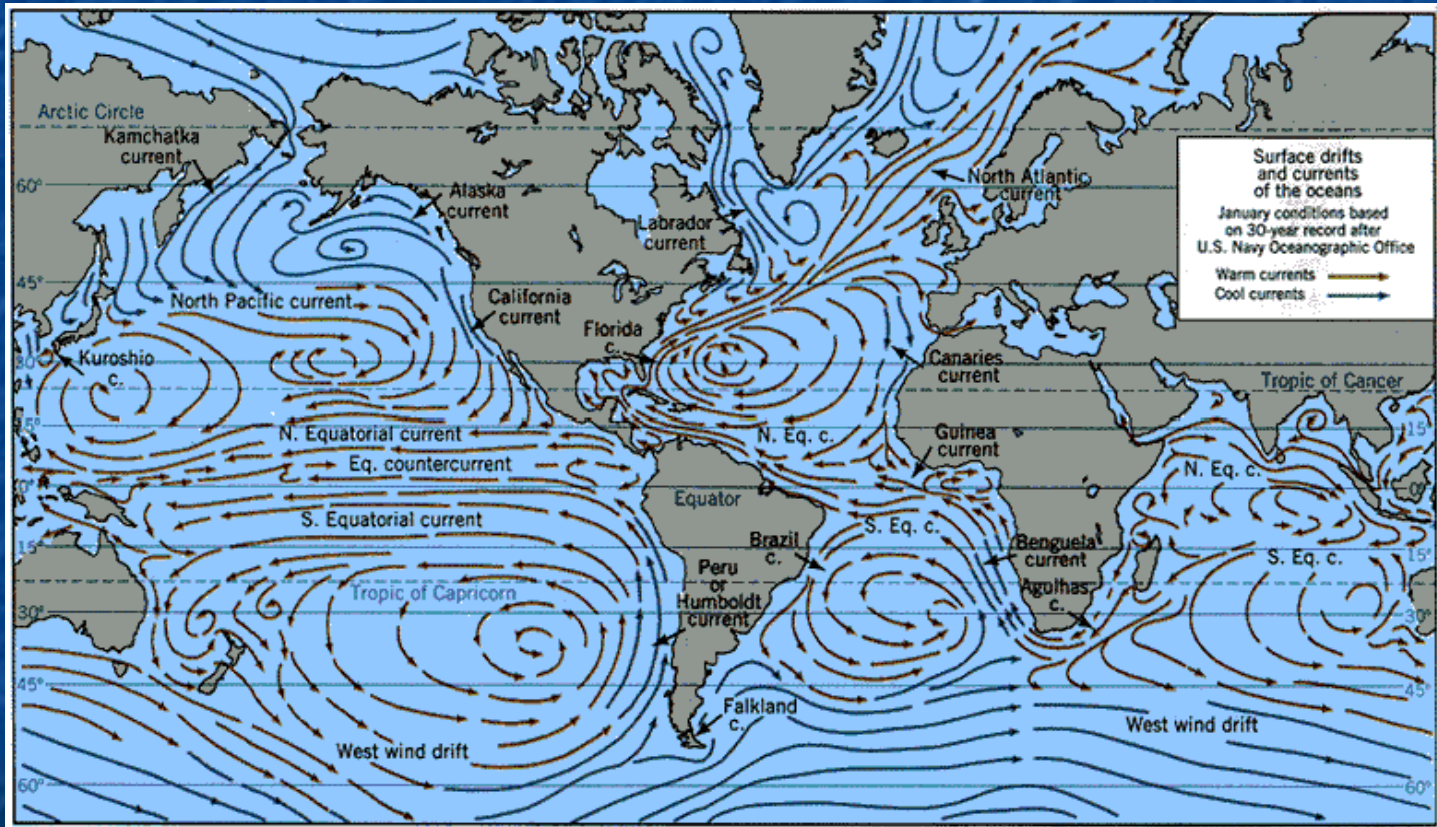
E4.2f - Explain how the Coriolis effect controls oceanic circulation.

Ocean's Vertical Structure



- The pycnocline, situated between the mixed layer and the deep layer, is where water density increases rapidly with depth because of changes in temperature and/or salinity.
- The dark, cold deep layer below the pycnocline accounts for most of the ocean's mass. Within the deep layer, density increases gradually with depth and water moves slowly; in only a few locations (usually near the bottom) are water movements fast enough to be considered currents.

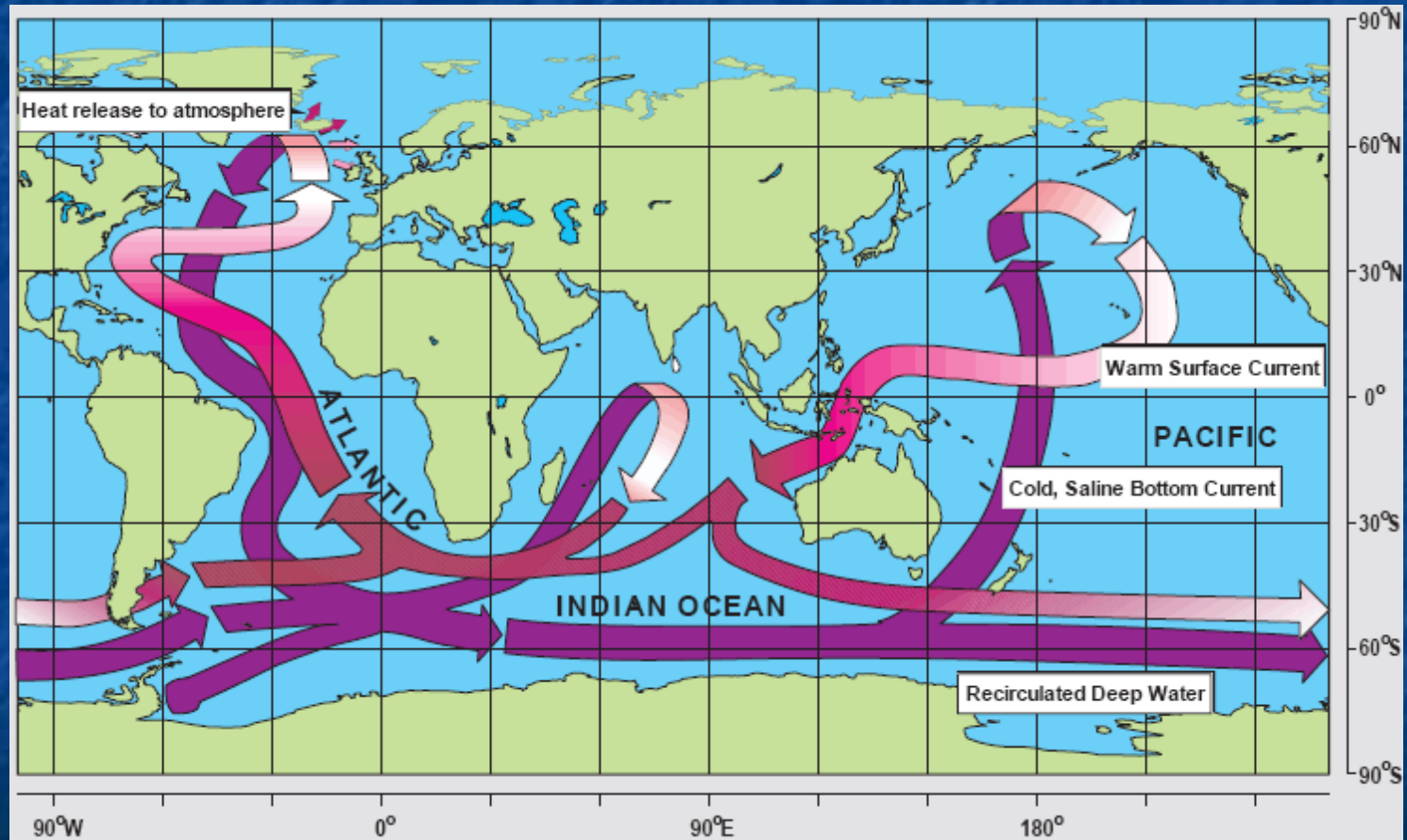
Ocean Currents (Shallow)



Ocean Currents (Shallow)

- Kinetic Energy(energy in motion) is transferred from near-surface winds to the Ocean's surface layer, driving the currents that dominate the motion of the upper few hundred meters of the ocean.

Ocean Currents(Deep)



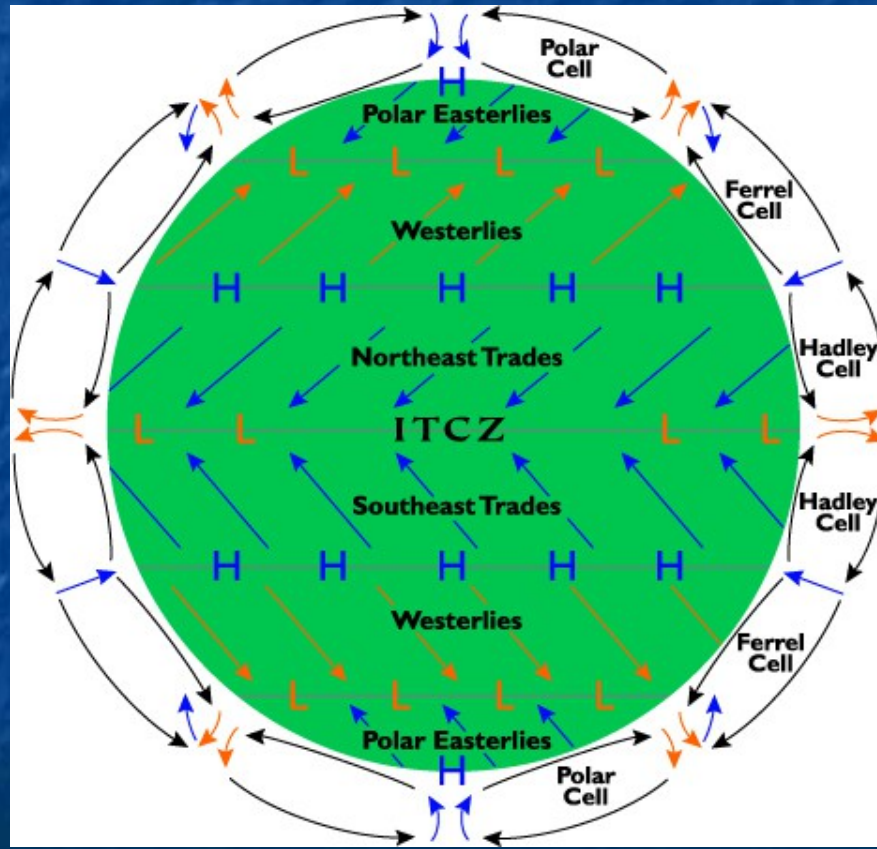
Ocean Currents(Deep)

- These bottom waters gradually warm and mix with overlying waters as they flow northward. They move to the surface at a rate of only a few meters per year. After rising to the surface in the Pacific, the surface waters flow through the many passages between the Indonesian islands into the Indian Ocean.

Causes of Ocean Currents

- Prevailing winds
- Coriolis Effect
- Unequal heating of the surface of the Earth
- Changes in water temperature
- Changes in Salinity
- Basin Shape

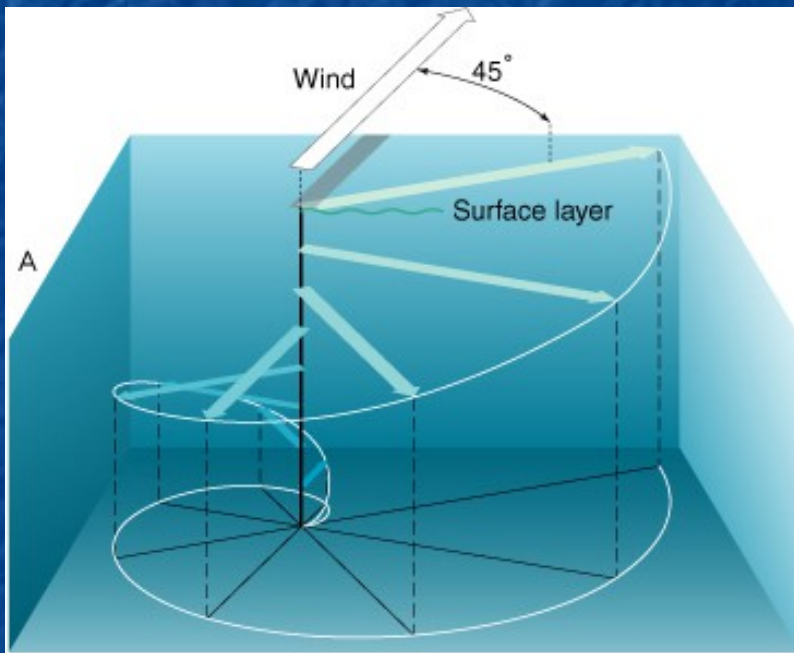
Prevailing Winds



Prevailing Winds

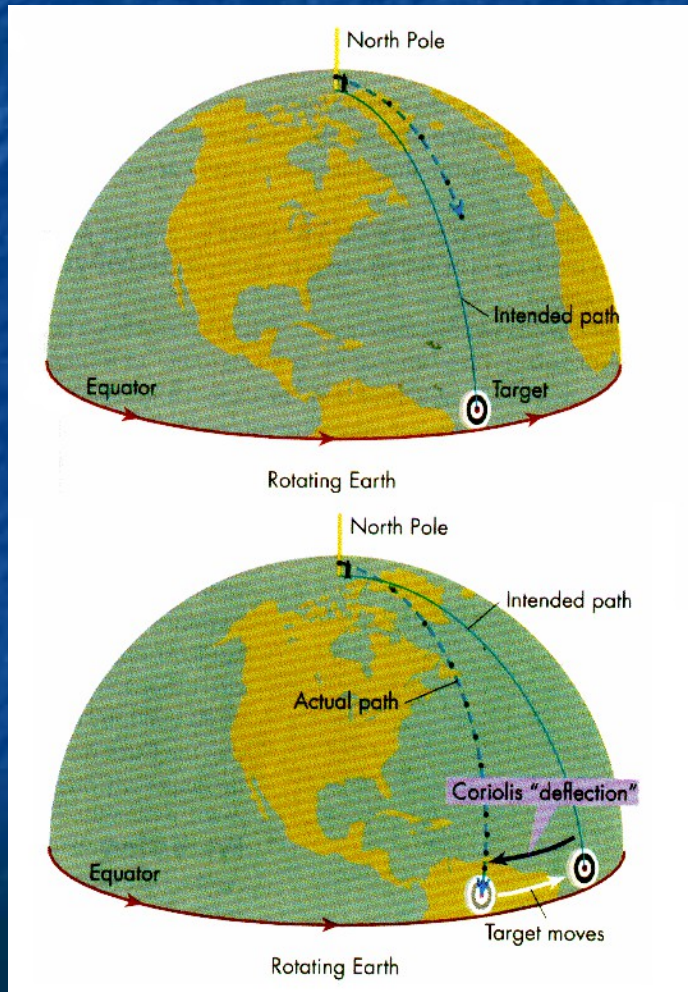
- Winds are responsible for not only horizontal currents but also vertical water motion within the surface layer.
- Wind driven surface currents are restricted to the ocean's uppermost 100m or less.
- The strongest currents occur in the ocean's surface layer. Example: Gulf Stream

Ekman Transport



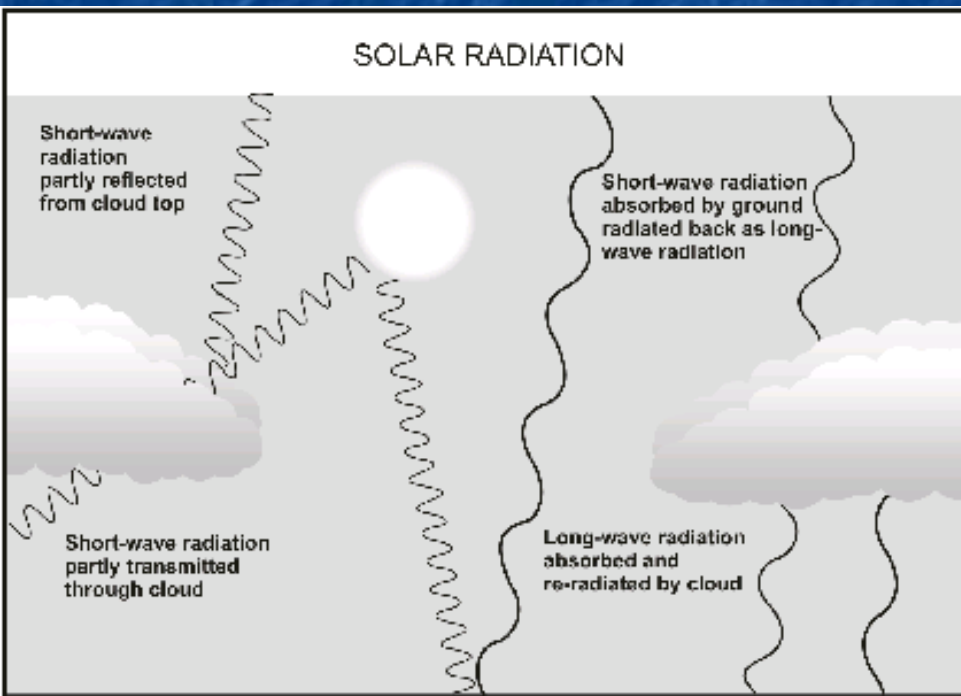
- The Ekman spiral indicates that each moving layer is deflected to the right of the overlying layer's movement; hence, the direction of water movement changes with increasing depth

Coriolis Effect



- The deflection of moving objects (air and water currents) due to the rotation of the Earth--to the right in the northern hemisphere, and to the left in the southern.

Unequal Heating



- sunshine heats up the surface of the land and ocean, although it heats the ocean more slowly than land.

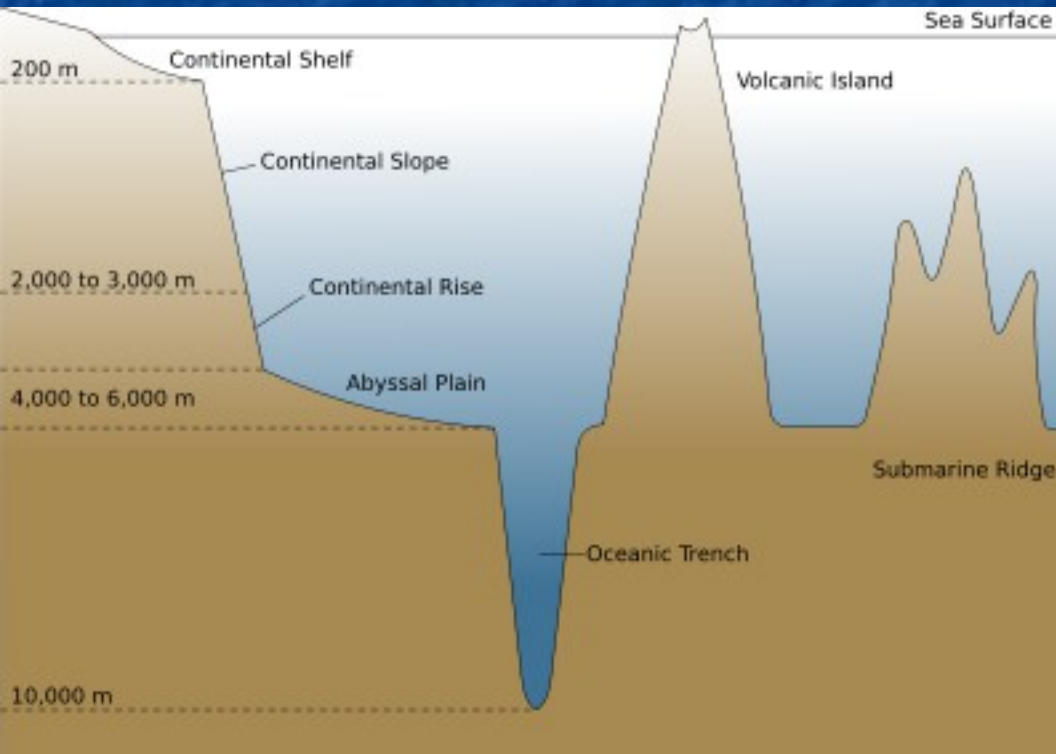
Changes in water temperature

- As the sun beats down and the ocean warms, water from the upper layer of the ocean evaporates. The conversion of liquid to vapor requires a lot of energy, so evaporation cools the top layer.

Changes in Salinity

- At constant temperature, the density of seawater increases with increasing salinity because the atomic mass of dissolved salts is greater than that of water molecules.
- Seawater density varies chiefly with temperature and salinity.

Basin Shape



- Turbidity Currents are a down slope flow of water heavily laden with suspended sediment rather than normal seawater

Websites:

www.Oceanmotion.org