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Class 15: PROPERTIES OF SEA WATER

Salinity

Effect of salinity on physical properties

ENERGY TRANSMISSION/ABSORPTION IN WATER AND SEA WATER

Heat

Light

SEA WATER is different from pure water because of dissolved salts in it.

Salinity (S) - - dissolved salt content in grams per kilogram seawater

Average S = 35 g/kg (other units are p.p.t., or ‰)

Range of S (99% of all sea water) = 30 -37 ‰

Dissolved salts change inter-molecular interactions and thus physical properties of sea water.

Boiling point = 103°C

Freezing point less than 0°C

Sea water begins to freeze at -2°C; as it freezes, salt is excluded from ice.

Important: Remaining water is saltier, so...

1) ...it freezes at lower T than the initial water

2) ...it is denser than the initial water (see more below)

Density increases with decreasing T all the way to freezing point (no strange behavior at 4°C fresh water- see above)

...Thus, the coldest water is also the densest (for a given salinity)

As seawater cools below 4°C, density increases

Very important: This means that the coldest ocean water sinks to the bottom.

Coldest areas of the oceans NOT stratified like freshwater lakes in winter

-Top layer is densest and may sink- convection currents

- bottom layer NOT stagnant like in lakes in winter

Sea Water Density...

... increases as S increases.

... increases as T decreases.

Very important! Convection occurs in the oceans.

Dense water found in some areas at the ocean surface SINKS

“Deep water” masses form in these areas because of:

... cooling (T decreases)

... freezing and/or evaporation (S increases)

These water masses sink to a level (depth) where their density is equal to that of the ocean water at that depth, and spread out

LIGHT ENERGY: TRANSMISSION & ABSORPTION

Radiant energy - - categorize based on wavelength (λ)

(or sometimes, frequency)

Solar energy- many wavelengths combined

Electromagnetic radiation spectrum:

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Longer wavelength -----> shorter wavelength
Infrared --> visible ---> ultraviolet --> x-rays

Radiant energy: direct transmission, through space, air, water, etc.

type of energy from a radiating object depends on it's surface T

Sun: 6,000°C -- visible light dominant in the radiant energy from sun

Earth: avg. = 18°C – **gives off infrared** (longer wavelengths- earth surface is cooler)

This is the major way that the earth releases heat into space

What would happen if the earth did not give off some energy into space?

Absorption of solar radiation by the oceans

Radiation reaching the sea surface:

-visible

-infrared = heat

-ultraviolet

Absorption of sun energy by water -- efficient, but depends on wavelength

How much energy or light is absorbed at various depths?

What kind of energy or light is absorbed at various depths?

<u>Depth</u>	<u>% absorbed</u>	<u>wavelengths absorbed</u>
1 m	60	infrared (heats surface waters)
10 m	80	longer visible
150 m	99	most

So...at 150 m, only short wavelength (green-blue-violet) light remains. The light is inky blue (for real, not just in movies).

Consequences: IMPORTANT

Photosynthesis limited to top 150 meters of the oceans

Blue color of sea water: shorter wavelengths only at depth

Conduction --

= heat energy transfer between touching substances: warm to cool

Surface of the ocean <--> atmosphere: conduction important

Conduction from surface of ocean to deep -- less important

Water is a poor heat conductor over long distances

If the ocean surface is warm, this warmth DOES NOT spread downward very much by conduction

Warm climate areas: Warm water on top, cold underneath

Convection is the more important heat transfer mechanism

-- heat transfer due to density-driven currents

-- Convection very important in the atmosphere and the oceans

Atmosphere- Heated at bottom, cooled at top. CONVECTION.

Convection in oceans

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-- driven by cooling of surface water and formation of sea ice AT HIGH
LATITUDE