# Lecture 9

## GLY102

## 3/2/2021

## The Motion of the Ocean

71% of Earth's surface is ocean.

> **Why are oceans important?**
>
> - We get a lot of food from the ocean
> - The oceans are taking in heat and absorbing a bunch of the $CO_2$ that we are emitting, saving us from an even worse greenhouse effect

**Ocean Acidification:** When the ocean absorbs CO2, it acidifies the water a little bit. Causes "coral bleaching"

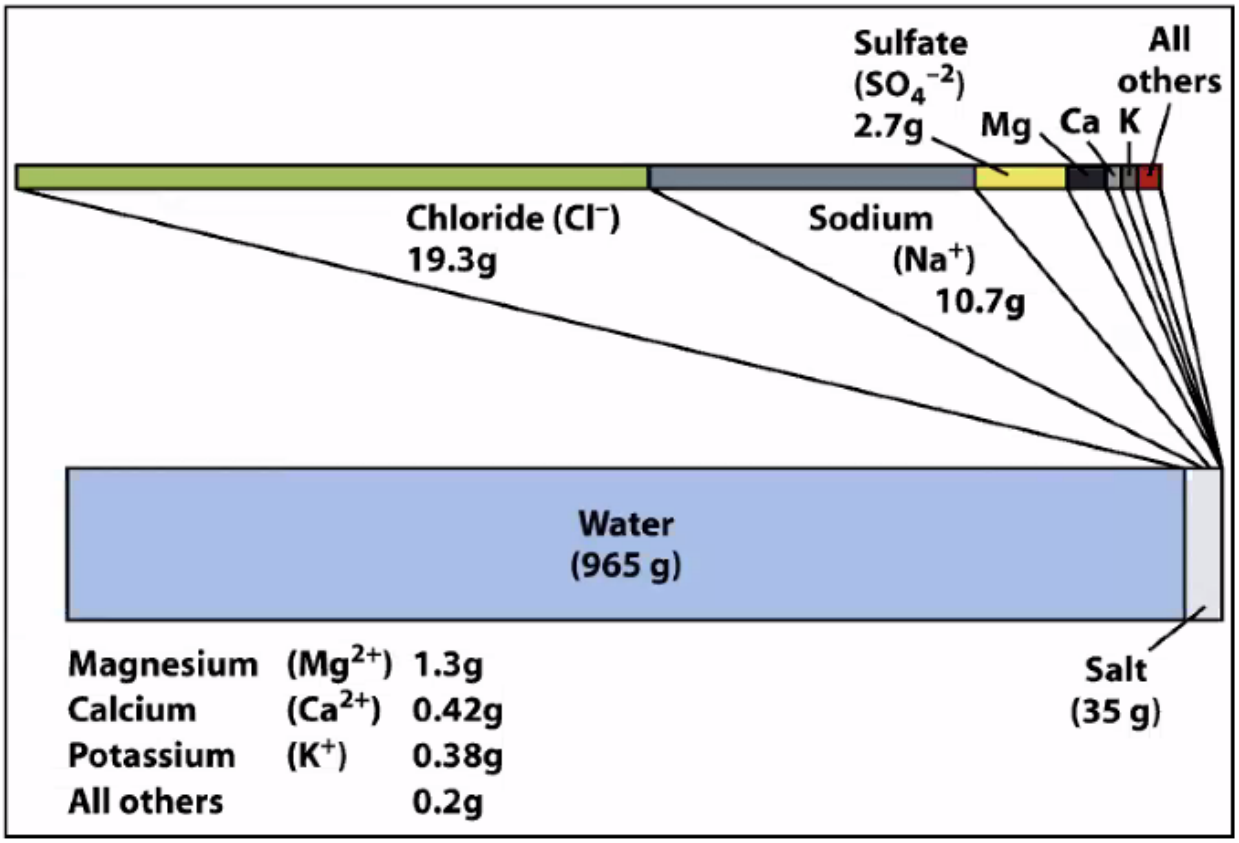
**How many oceans are there on planet Earth?** Depends on how you define them! Historically, four named oceans: Pacific, Atlantic, Indian, and Arctic. In recent years, a fifth is sometimes added: The Southern Ocean.

## Characteristics of Seawater:

### SALINITY

- **Salinity -** number of grams of salts dissolved in 1000g of water, expressed as parts per thousand (example: 35 $^{0}/_{00}$)
- Ions derived mostly from chemical weathering on land.
  - In decreasing order of abundance:

$$Cl^-,\ Na^+,\ SO_4^{2-},\ Mg^{2+},$$
$$Ca^{2+},\ K^+,\ \text{etc.}$$

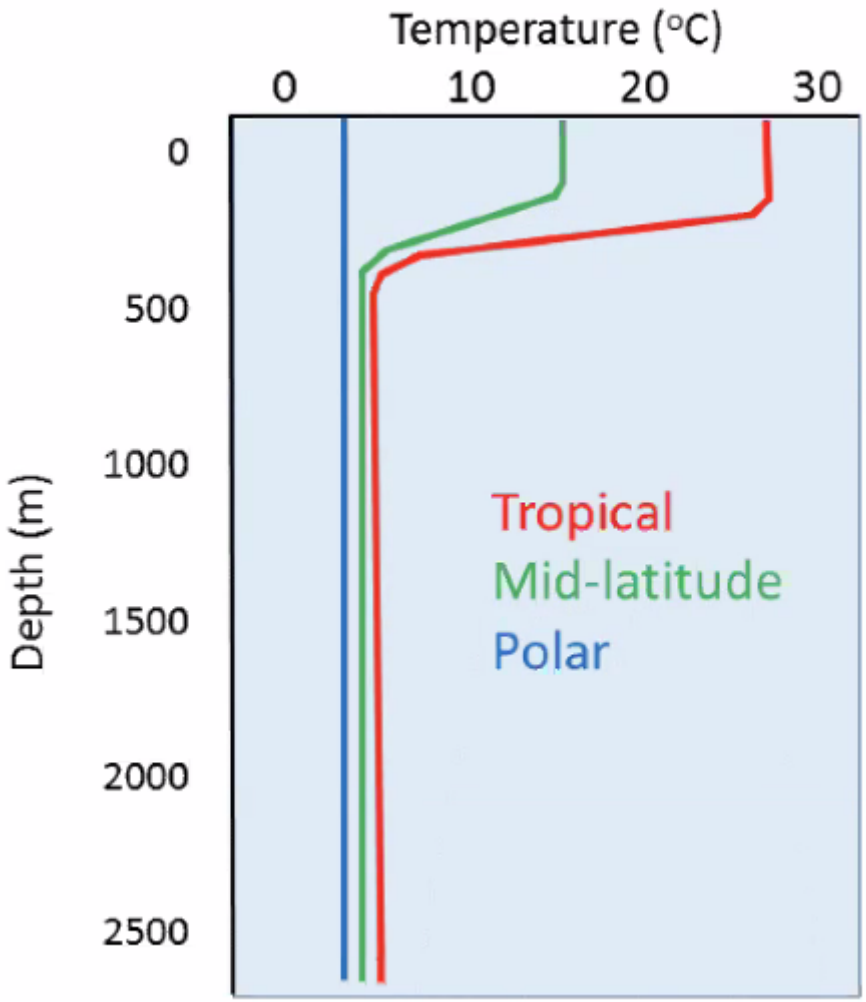



### Why does salinity vary?

- Surface water salinity averages $35^0/_{00}$
  - Higher salinity – from evaporation and sea-ice formation.
  - Lower salinity – from rainfall, glacial melt, and river input.
- Salinity becomes more uniform with depth
  - High latitudes have lower salinity
  - The tropics are more saline, likely because there is more evaporation there (left over is the salt, water gets evaporated, hence more saturated with salts)
  - **Halocline:** Zone of rapid salinity change

## TEMPERATURE

- Temperature versus depth:




  - Surface water is warm so it doesn't want to sink!
  - Below 300 m in the tropics: Near freezing (polar water is always near freezing)
  - Abrupt temperature change is called the **Thermocline**

### DENSITY

- Salinity and Temperature influence **density**!
  - Increased Salinity = increased density
  - Decrease Temp = Increased Density
- Why does water density matter?
  - Denser water will SINK, carrying surface waters to the deep ocean basin!
  - Sinking surface water brings Oxygen and nutrients to the bottom!

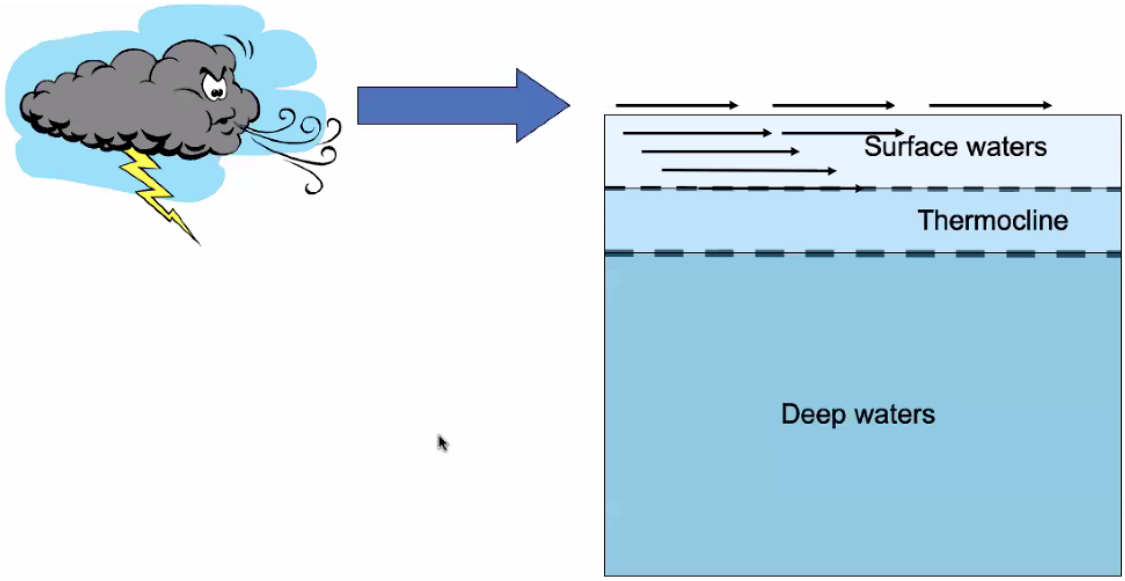
## Ocean Currents

> **Why are there ocean currents?**

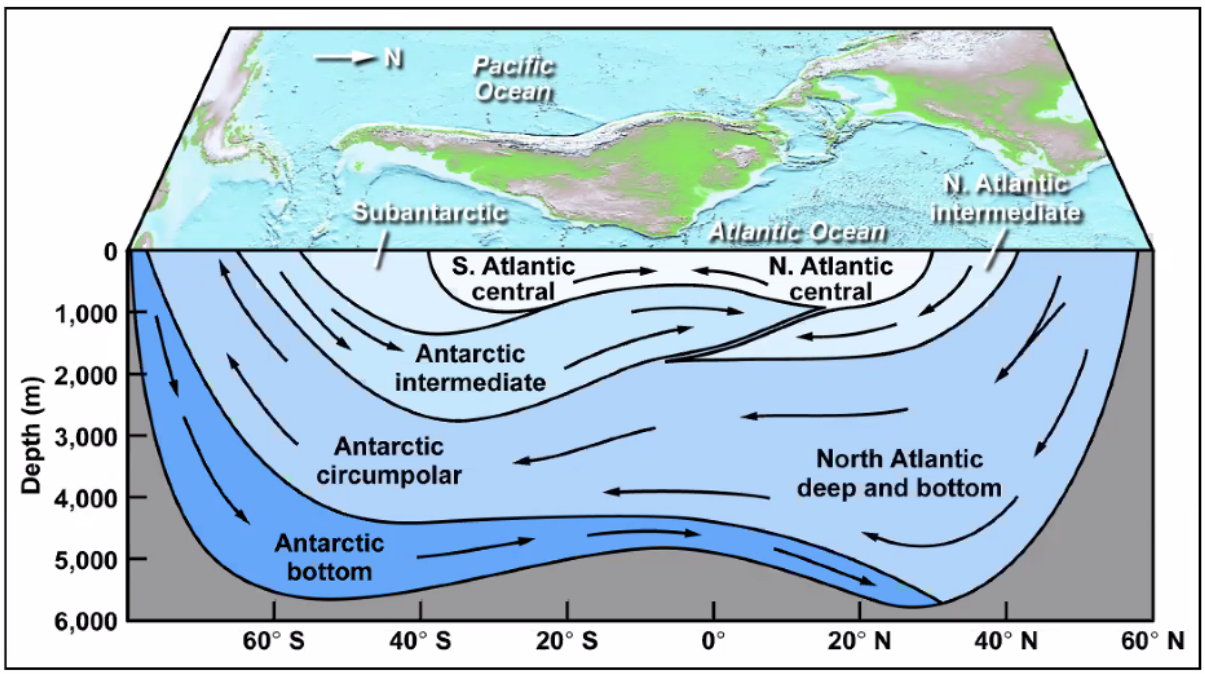
> The moon doesn't really cause an effect far away from land.
> The wind and density are both the big causes for ocean currents.

## Ocean Circulation

- **Ocean Current**: Well defined streams of water moving in the ocean
- Two general varieties of currents:
  1. Surface currents
     - Driven by WIND




     - These currents only affect about 100m of the ocean in terms of depth
  2. Vertical Currents - **Subsurface** flow (deep ocean)
     - Driven by DENSITY




- A key concept in ocean circulation:
  - **"Upwelling" and "Downwelling"**

- **Upwelling:** when deep water rises vertically to the surface
- **Downwelling:** when surface water sinks vertically downward into the deep ocean