



# Earth and Space Science

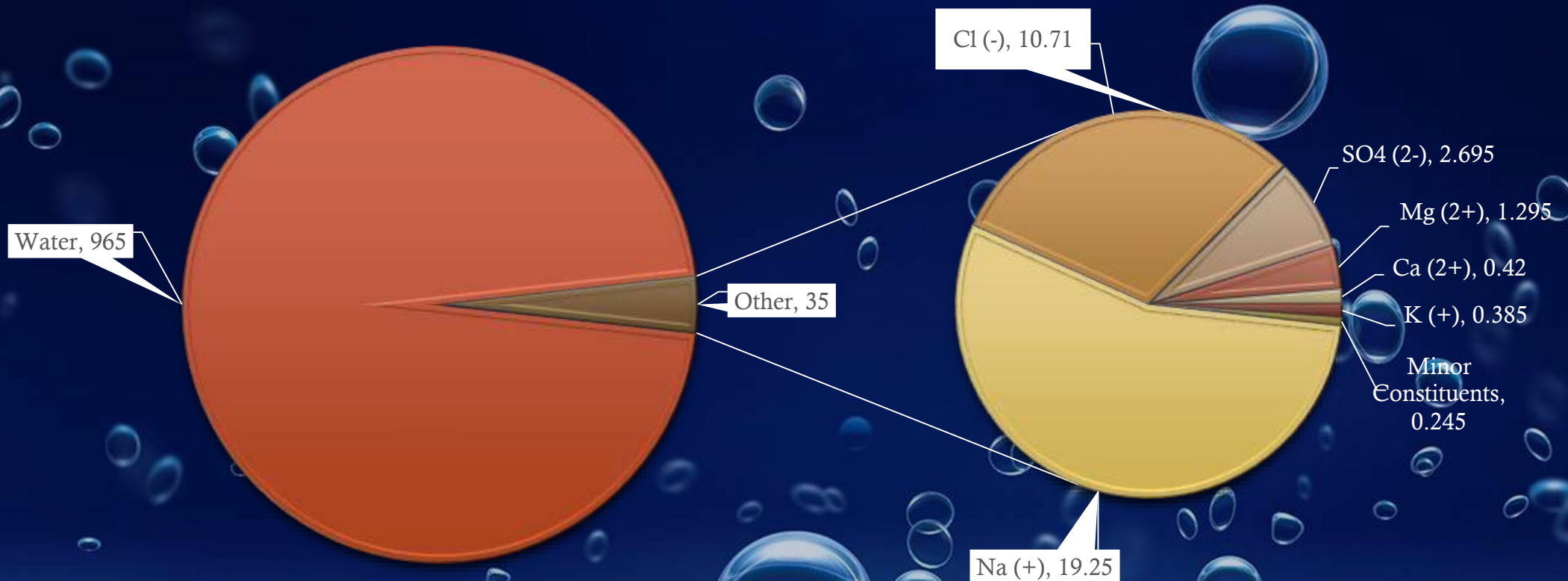
Unit 6 Lecture 2: Ocean Water

(Chapter 14)

# Salinity

- ◆ Is the total amount of solid material dissolved in water.
- ◆ The average amount of salt in the Seawater is 3.5% (by weight) of dissolved minerals
- ◆ Salinity
  - ◆ Proportion of dissolved salts
  - ◆ Measured in parts-per-thousand (‰)
  - ◆ Salinity of open ocean: 33‰ to 37‰
  - ◆ Major constituents:  $\text{Cl}^-$  and  $\text{Na}^+$
- ◆ Sources are Chemical weathering of rocks and outgassing (gases from volcanic eruptions)

# Composition of Seawater



# Processes Affecting Seawater Salinity

- ◆ Large amounts of freshwater are being dumped in the ocean, decreasing salinity

- ◆ Sources:

- ◆ Rain and Snow

- ◆ Discharge of Rivers

- ◆ Melting of Icebergs and Sea Ice

- ◆ Processes that remove freshwater from seawater, decreasing salinity

- ◆ Sources:

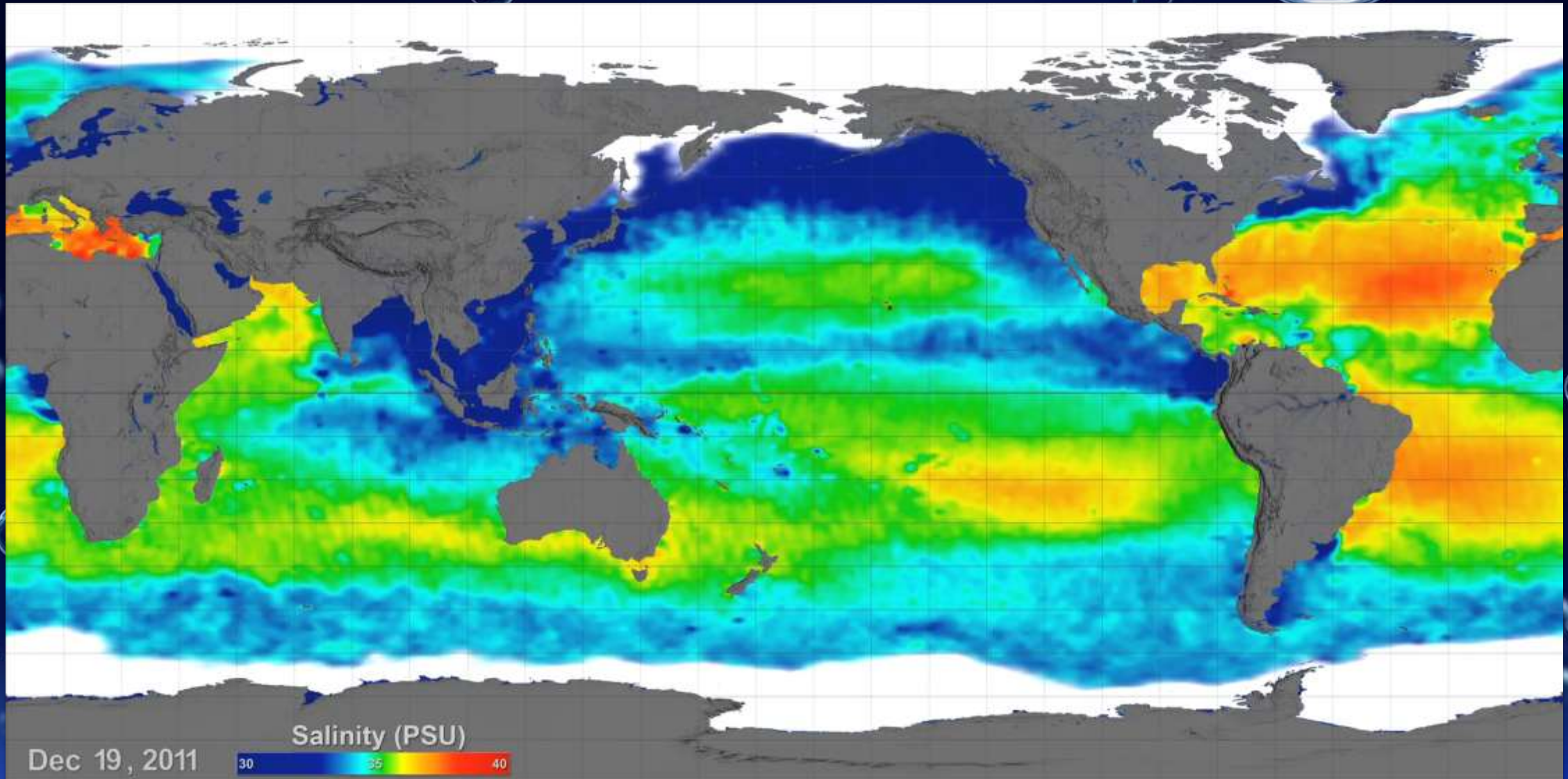
- ◆ Evaporation

- ◆ Formation of Sea Ice

# Process Affecting Seawater Salinity (cont.)

- ◆ High salinities are found where evaporation rates are high, as is the case with the sub tropic region (roughly between  $25^{\circ}$  and  $35^{\circ}$  North or South latitude)
- ◆ Conversely, where large amounts of precipitation dilute ocean waters, as in the mid-latitudes (between  $35^{\circ}$  and  $60^{\circ}$  North or South latitude) and near the equator, lower salinities prevail.
- ◆ Surface salinity in the polar regions varies due to the formation and melting of polar sea ice.
  - ◆ Winter when sea ice forms, sea ice doesn't contain salts, so salinity of the surrounding waters increases
  - ◆ In summer when the sea ice melts, the surround waters are diluted and salinity decreases

# Surface Salinity in Motion

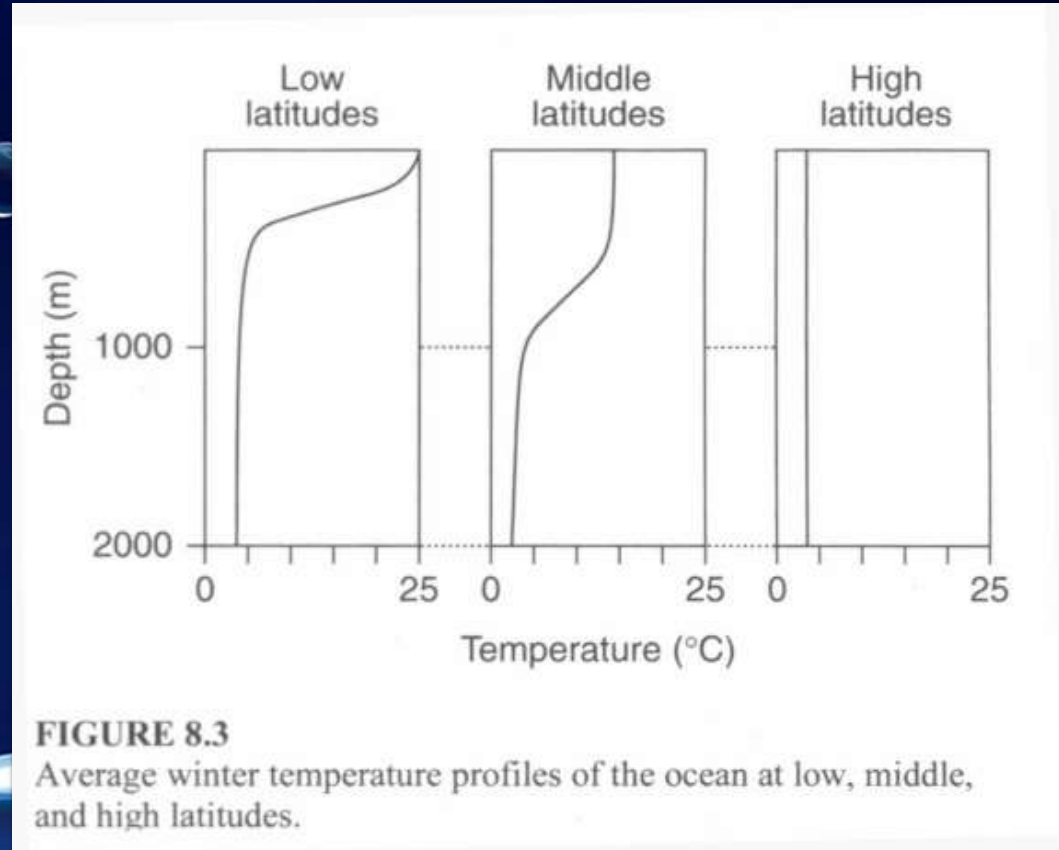


# Recent Increases in Ocean Acidity

- ◆ The burning of fossil fuels has increased the amount of  $\text{CO}_2$  in the air
- ◆ About 1/3 of human generated Carbon Dioxide ends up dissolved in the oceans
- ◆ This causes the Ocean pH to drop, making the seawater more acidic.
- ◆ When Carbon Dioxide ( $\text{CO}_2$ ) is dissolved in water ( $\text{H}_2\text{O}$ ), it forms carbonic acid ( $\text{H}_2\text{CO}_3$ ).
- ◆ This lowers the pH of the seawater and changes the balance of certain chemicals found naturally in sea water.
- ◆ Currently we have experienced a pH drop of 0.1 on the pH scale
- ◆ Scientists believed that by 2100 AD we will have had a pH drop of 0.3, a number that has not occurred on Earth in Millions of years.

# Temperature Variations

- ◆ As we get deeper within the ocean we expect the water to get colder
- ◆ In the Low-latitudes we start out with a higher temperature but the temperature greatly decreases with depth because of the inability of the Sun's rays to penetrate very far into the ocean
- ◆ In the High-latitudes, surface water temperature is much cooler and the temperature of the deep ocean is similar to that of the surface so the curve remains vertical as there is no change in temperature with depth

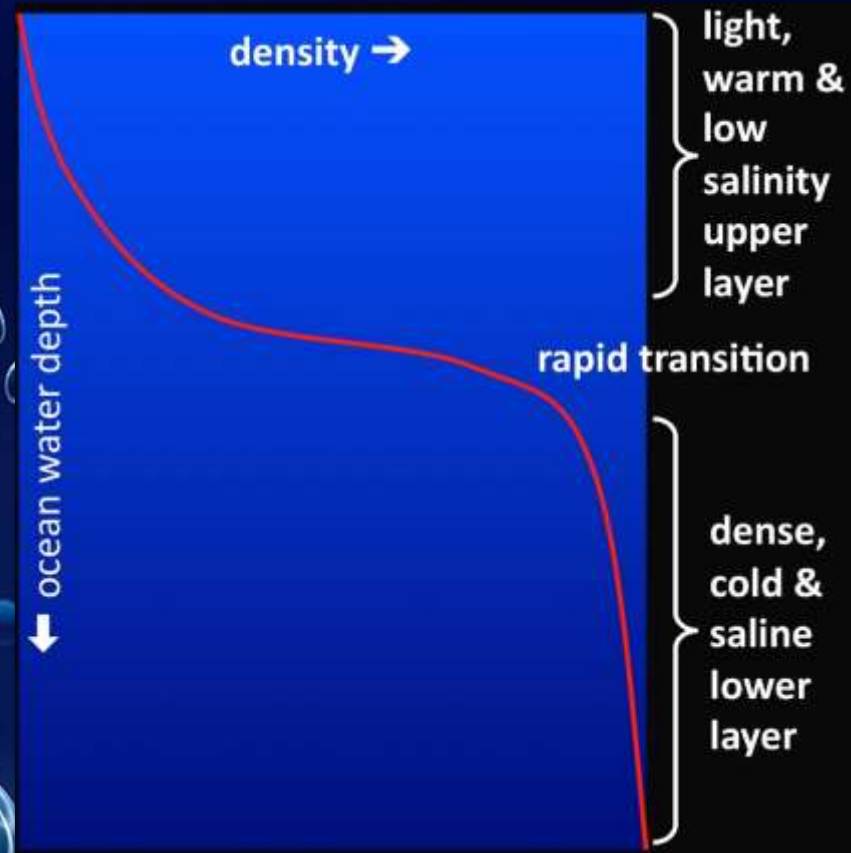


**FIGURE 8.3**  
Average winter temperature profiles of the ocean at low, middle, and high latitudes.



# Density Variations

- ◆ Two factors affect the density of Seawater: *salinity* and *temperature*
- ◆ Temperature is an inverse relationship where salinity is a direct relationship
- ◆ Latitude also affects Density, low-latitudes have a decrease in density with depth (associated with the drop in temperature) we call this the *pycnocline*
- ◆ High-latitudes don't have a drop as the temperature doesn't vary with depth



# Ocean Layers

