

Andrew Friedland • Rick Relyea

- **Environmental Science**
  - **FIRST EDITION**

**CHAPTER 4**  
Global Climates and Biomes

# Food, Drought and Famine



## **Chapter 4 Opener**

*Environmental Science*

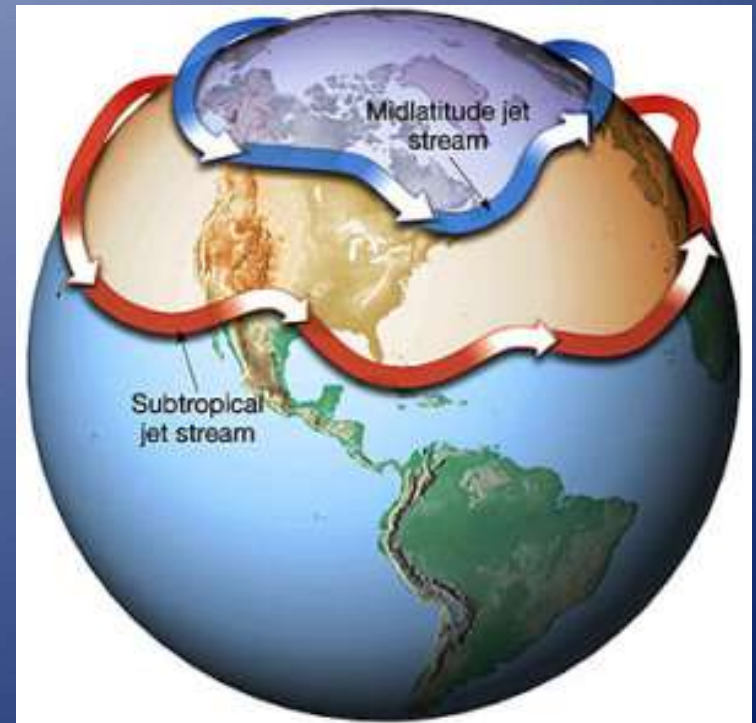
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# Weather -v- Climate

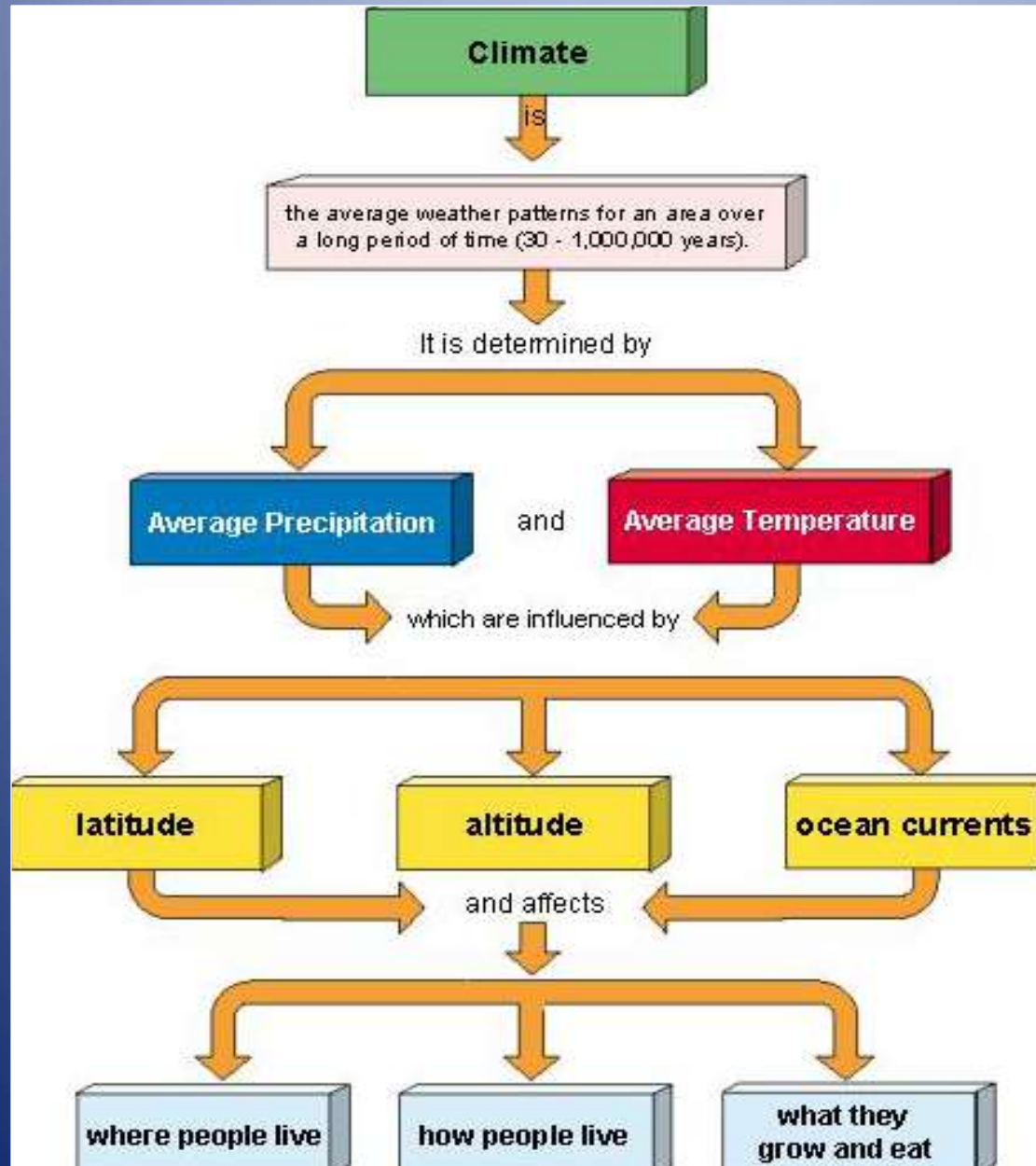


# What influences weather and climate?

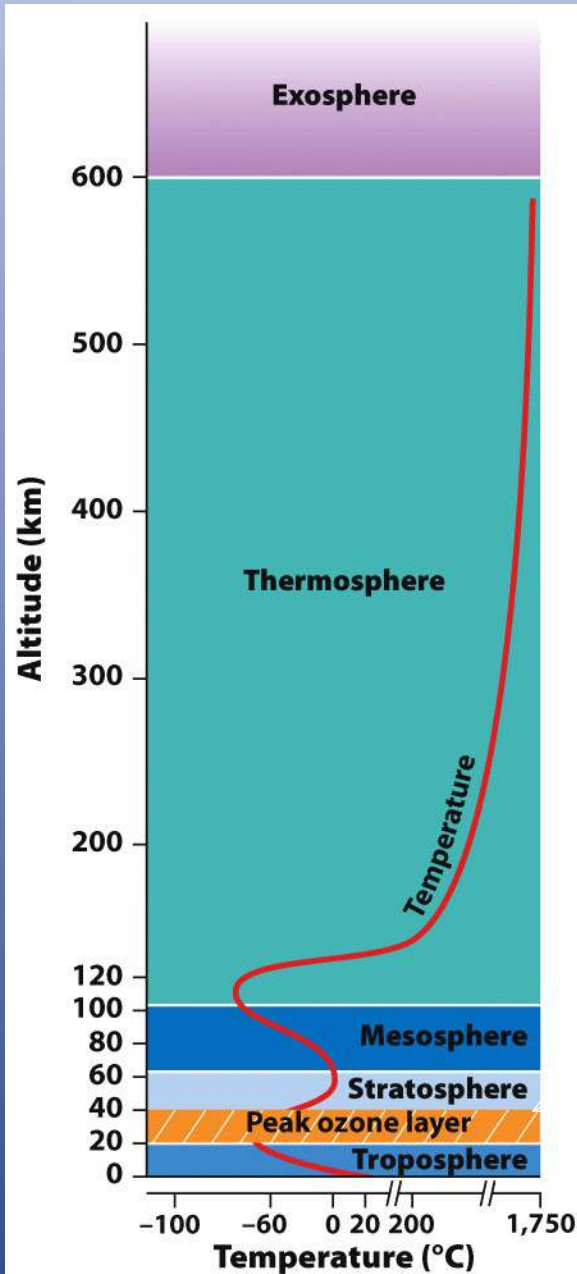
1. Unequal heating of Earth
2. Atmospheric convection currents
3. Rotation and Coriolis Effect
4. Earth's orbit and tilted axis
5. Circulation of ocean waters



# Studying Climate and Weather



# 5 Layers of Atmosphere

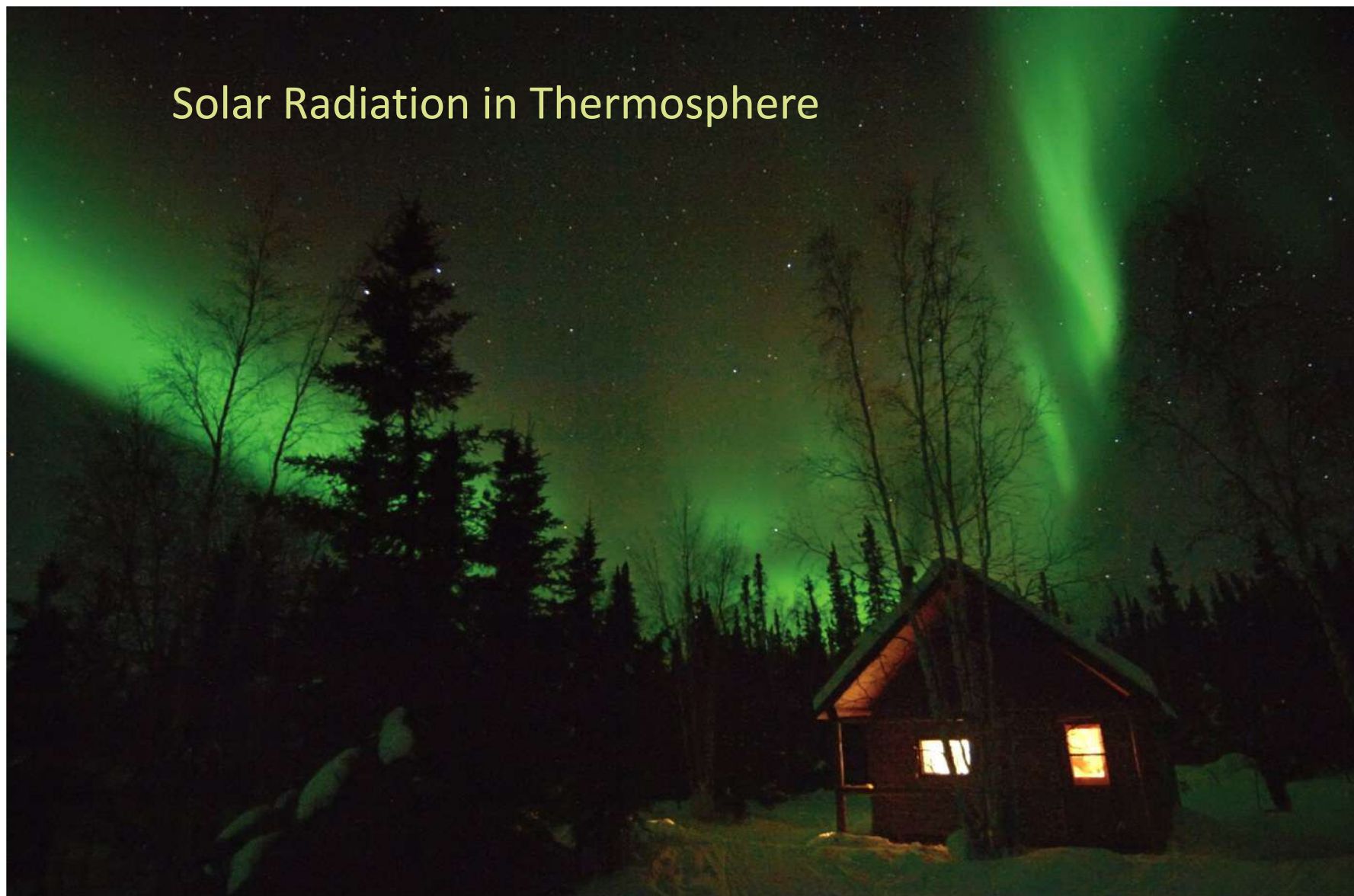


Ozone !!

N<sub>2</sub>, O<sub>2</sub> & H<sub>2</sub>O

**Figure 4.1**  
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## Solar Radiation in Thermosphere



**Figure 4.2**

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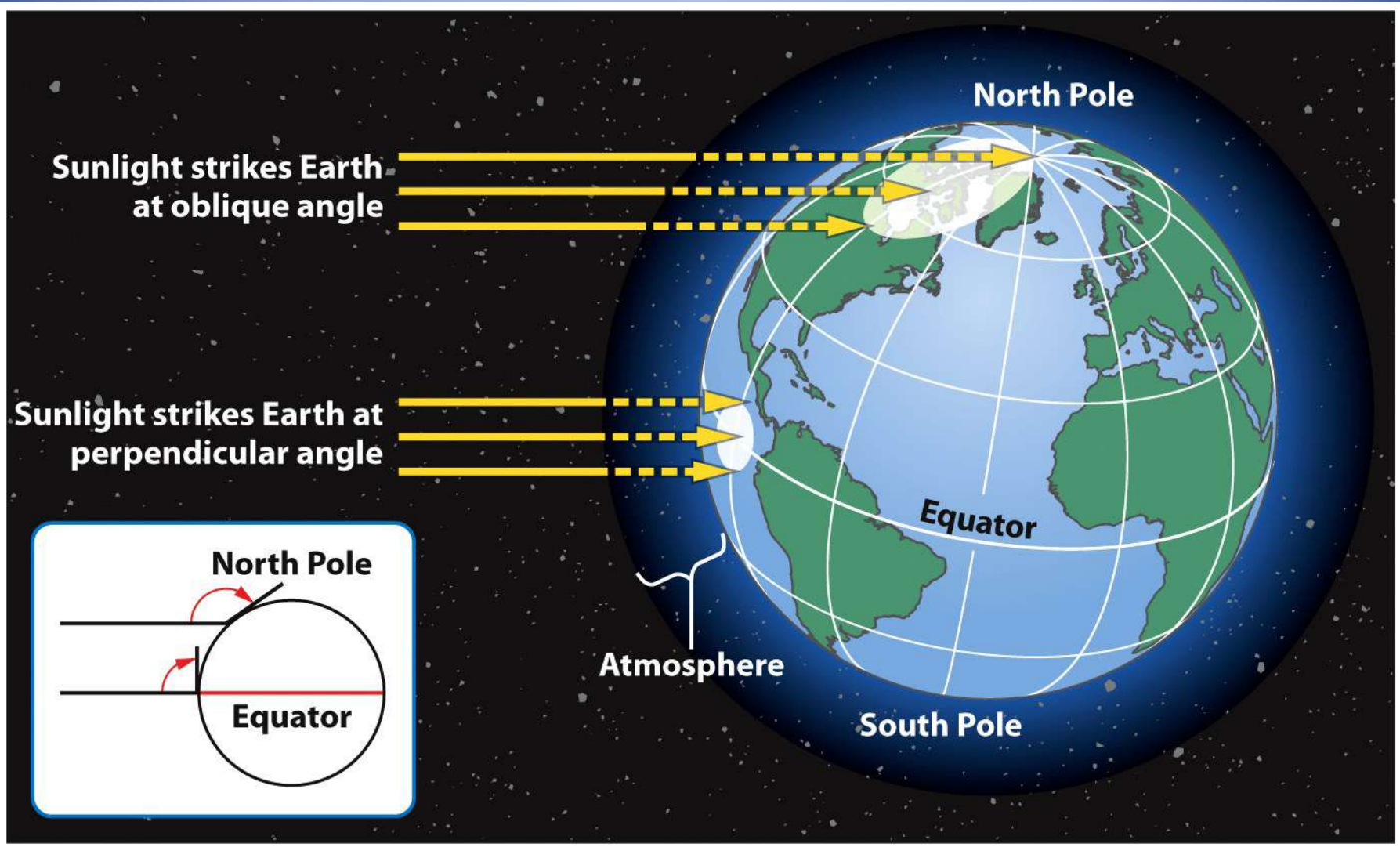
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# Unequal Heating of Earth

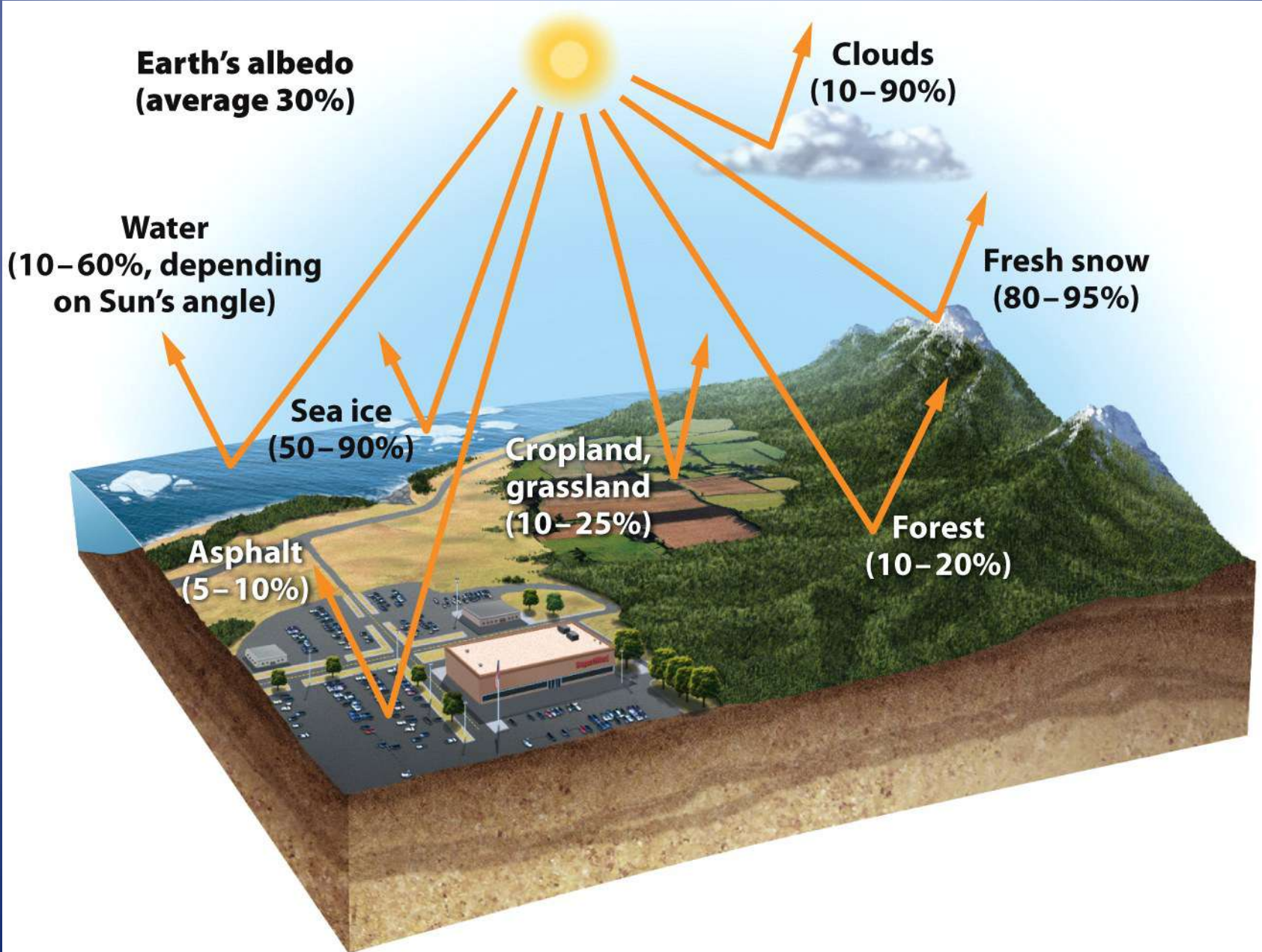
1. Angle of sun through atmosphere
2. Angle of sunlight across surface
3. Albedo







**Figure 4.3 part 1**  
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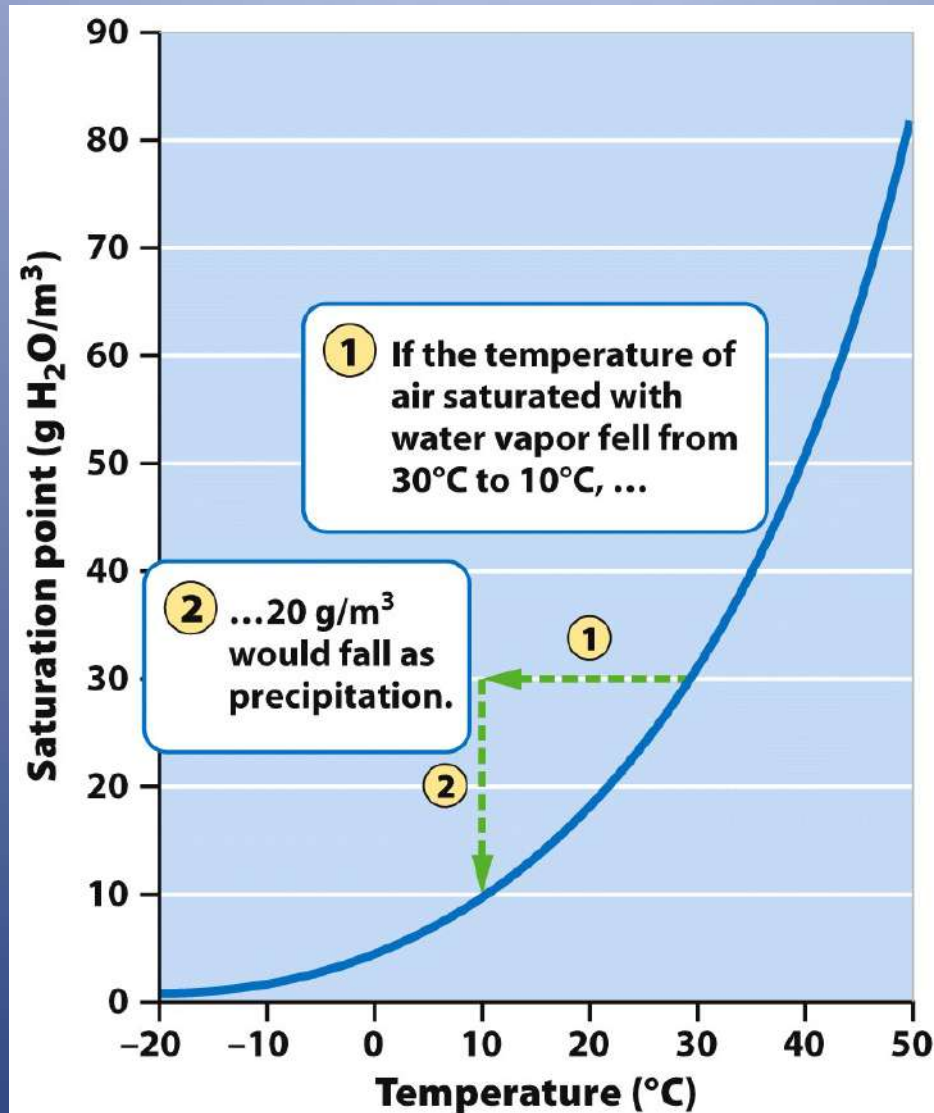


**Figure 4.4**

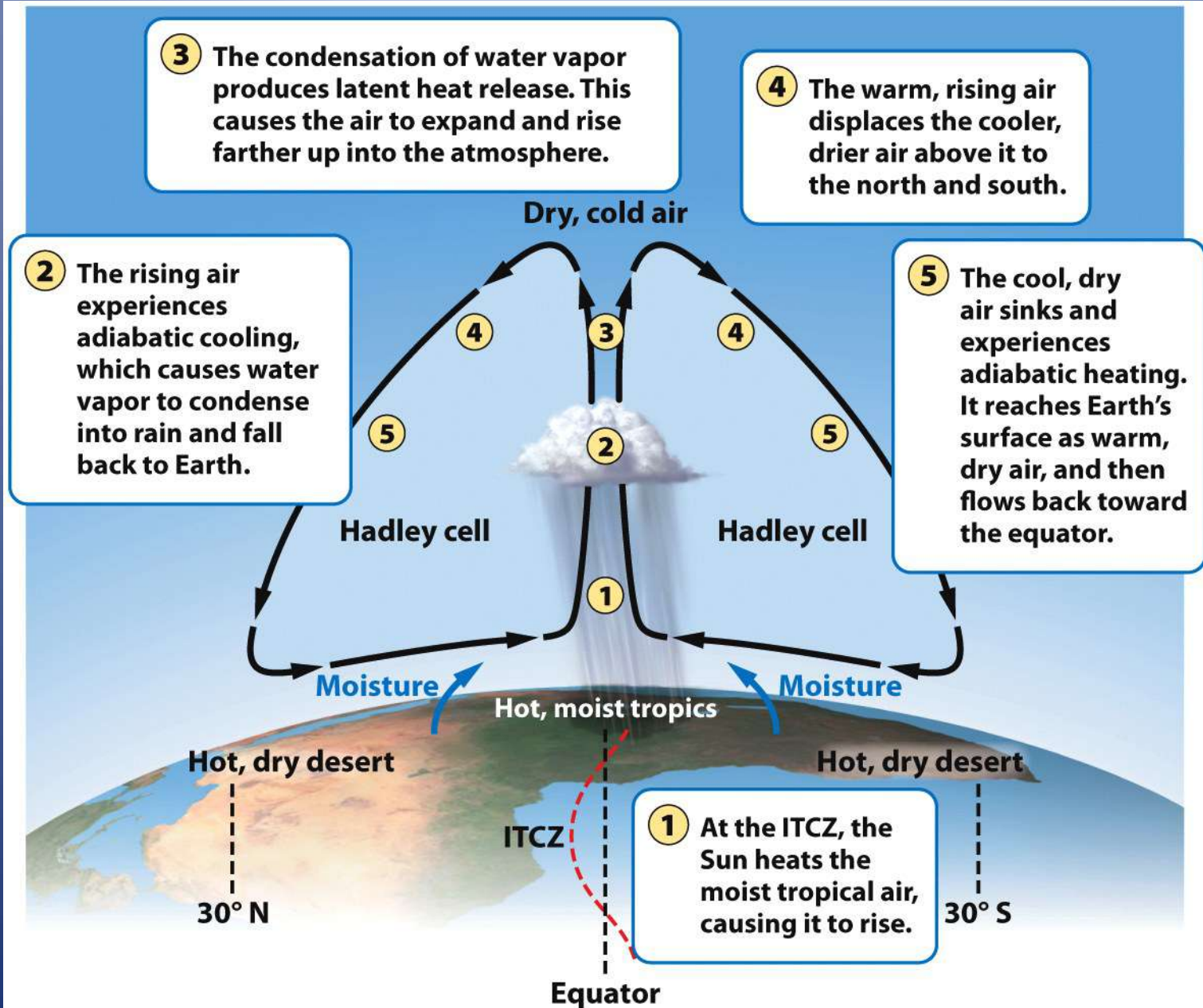
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# Why does it rain so much at the equator?



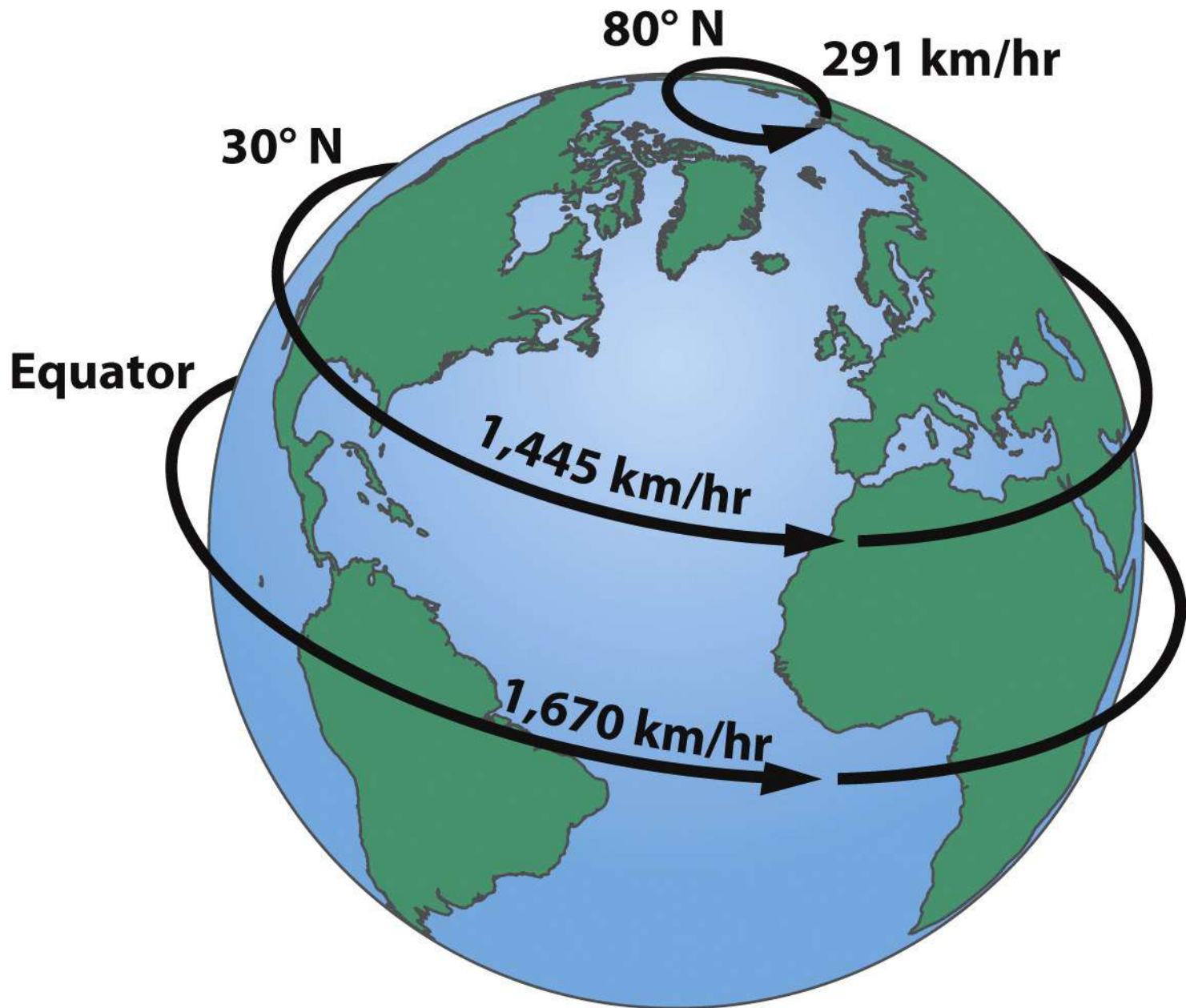
**Figure 4.5**  
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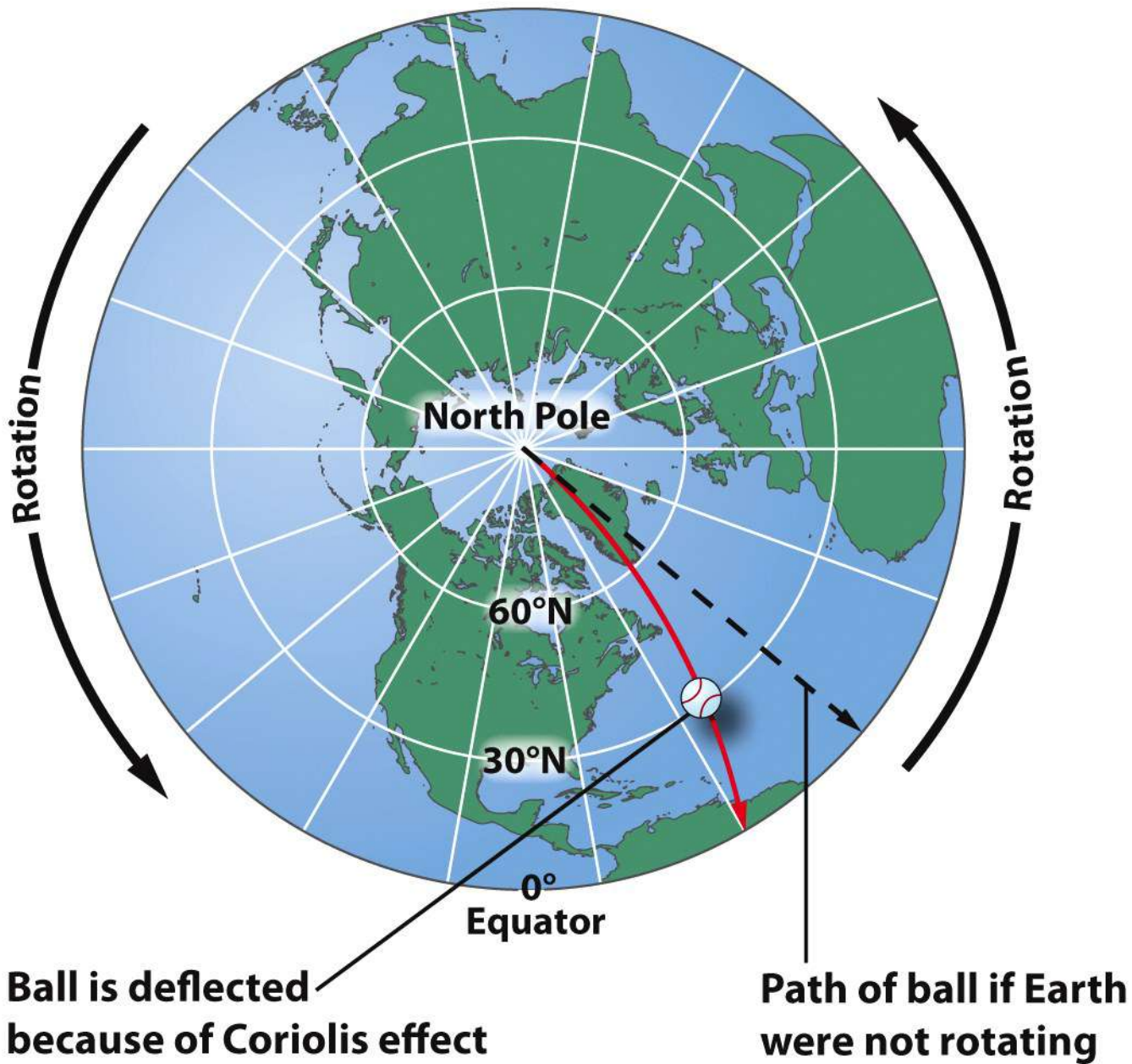
**Figure 4.6**

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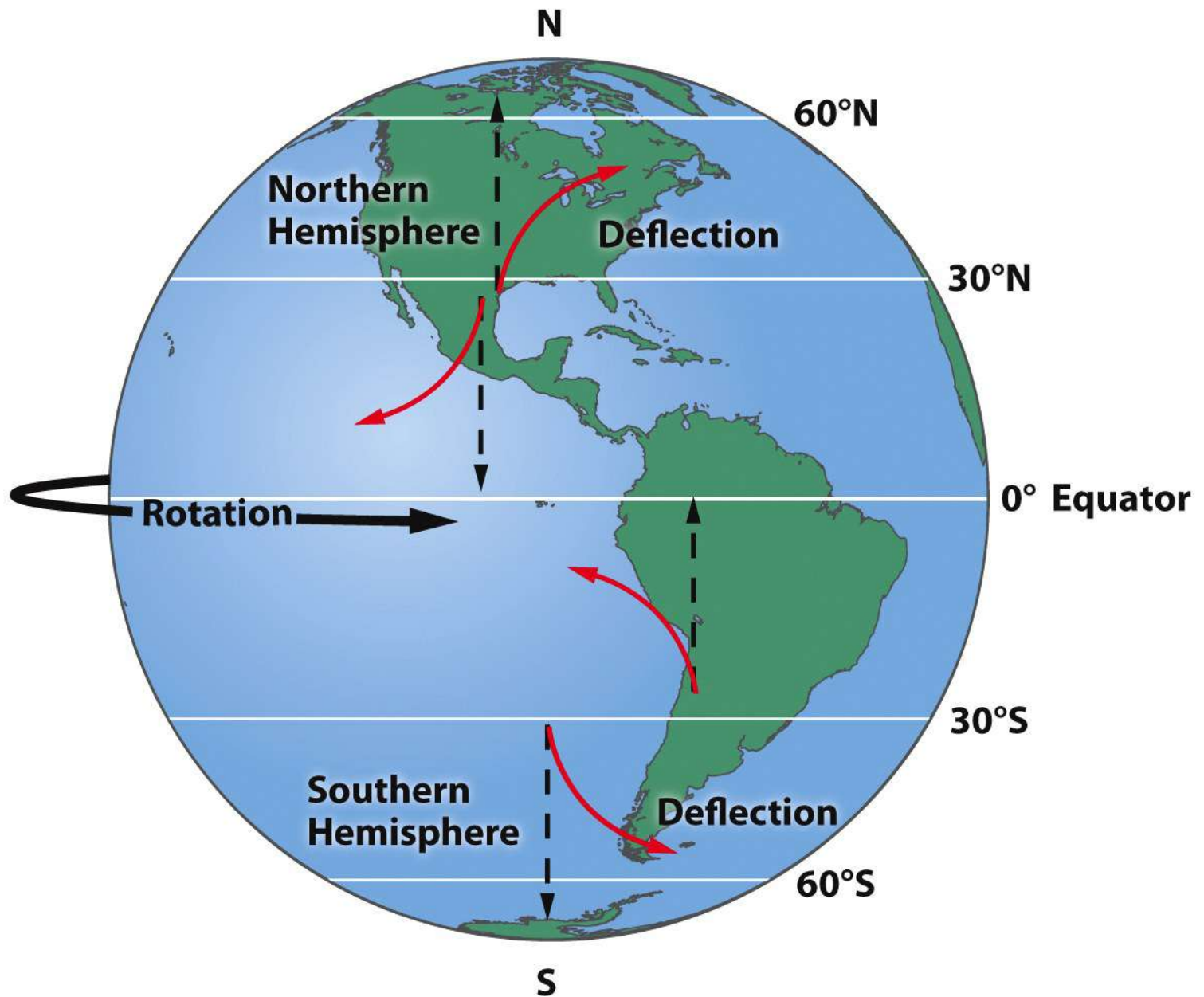
**Figure 4.7**  
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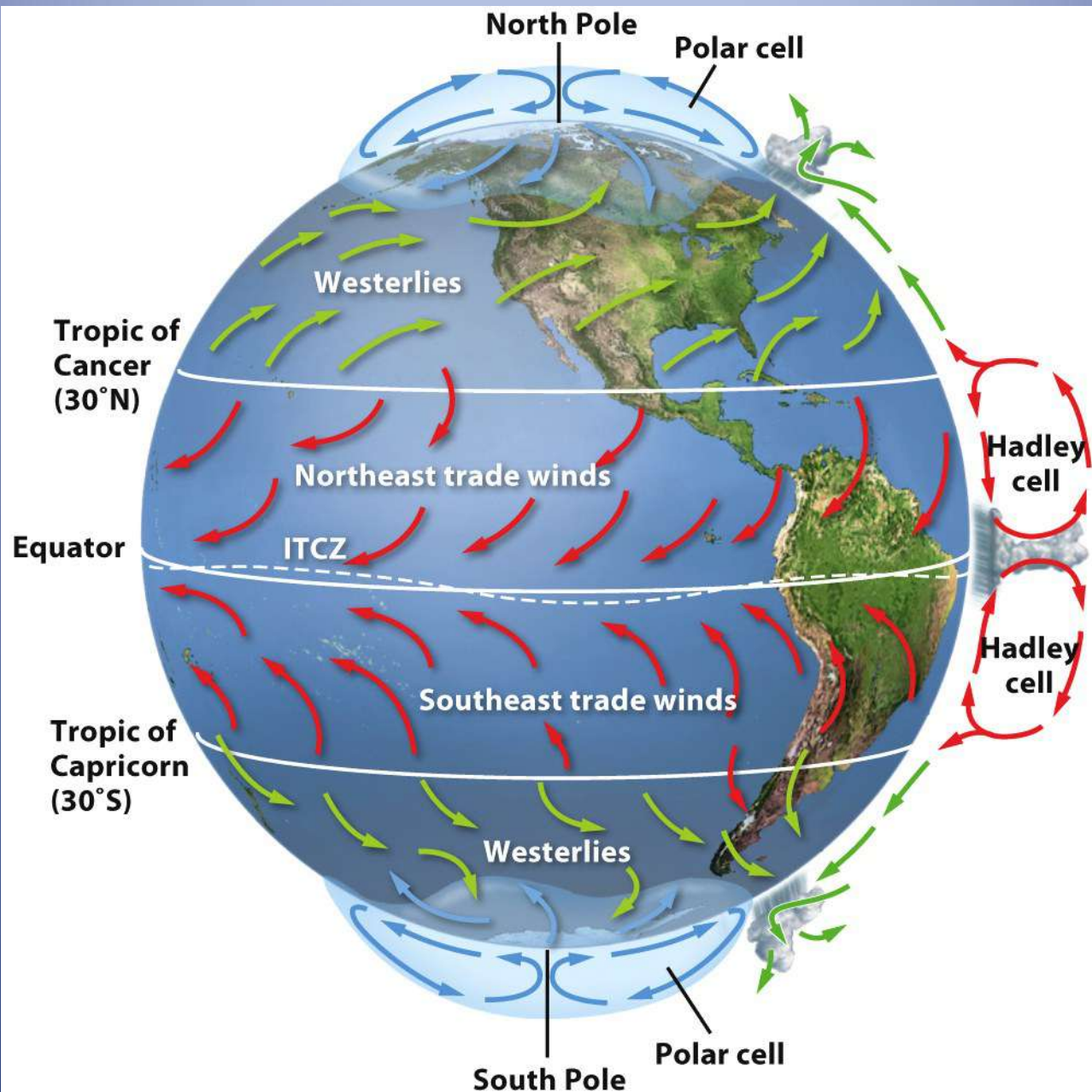
**Figure 4.8a**

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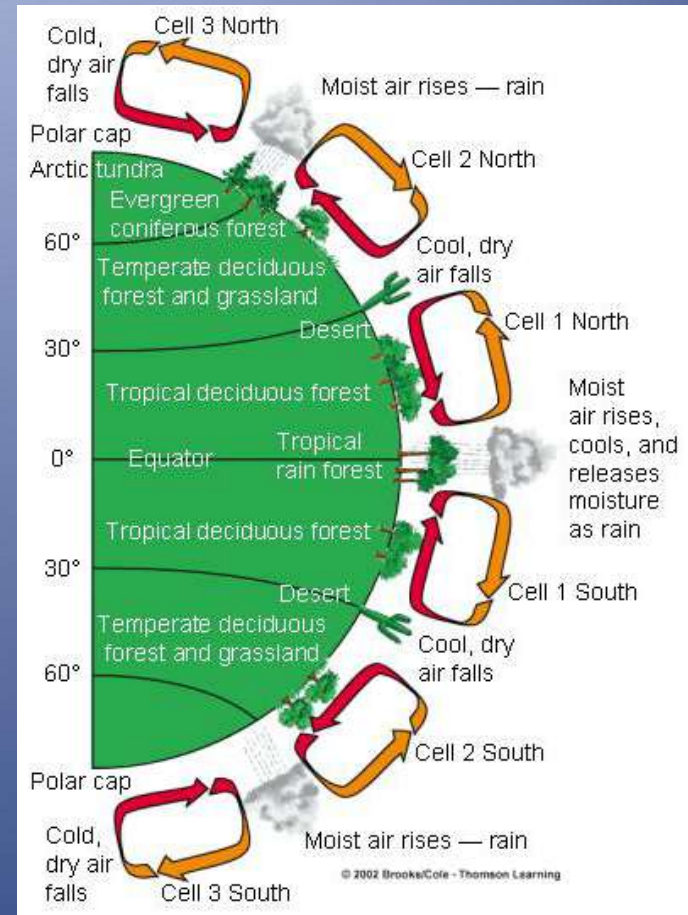
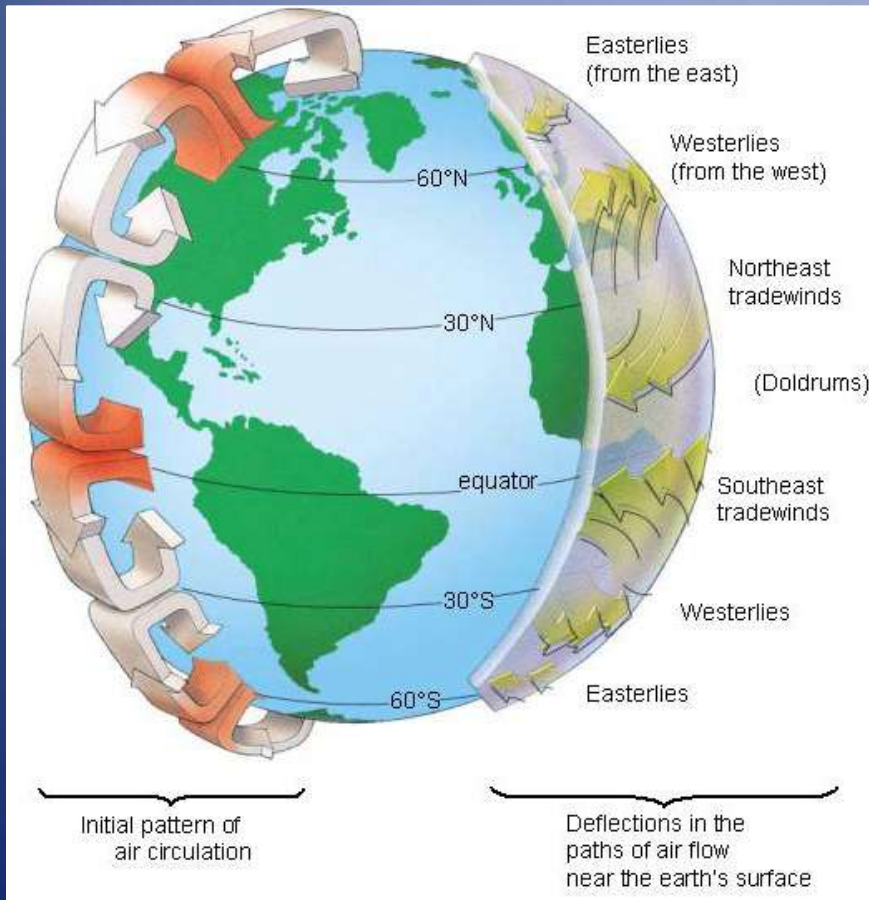
**Figure 4.8b**  
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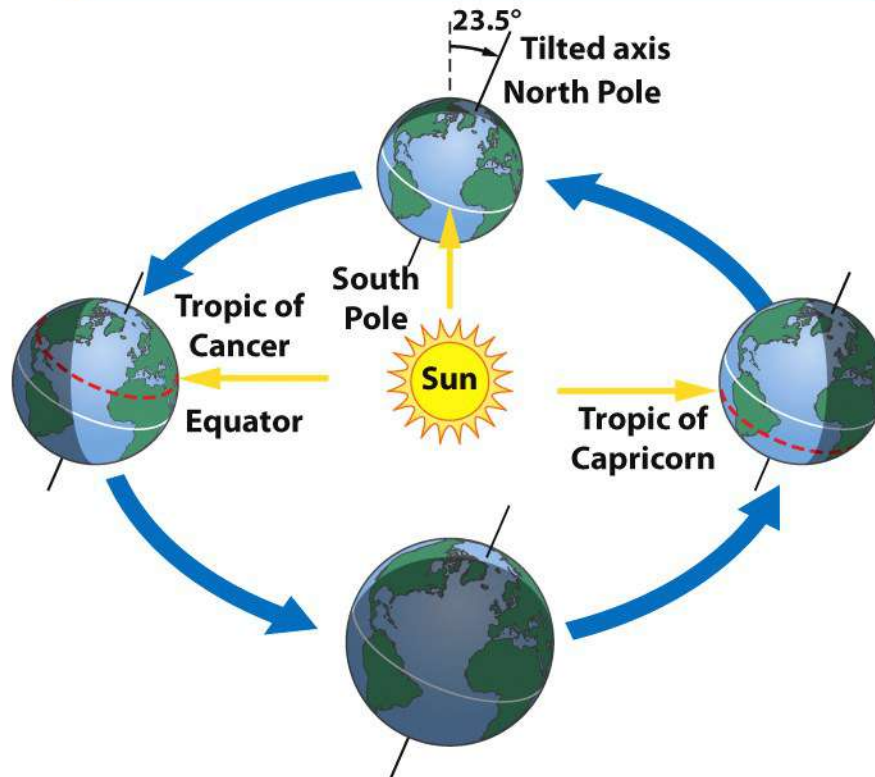
**Figure 4.9**  
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# Air Circulation & Biomes



**1 March equinox**  
The Sun is directly overhead at the equator and all regions of Earth receive 12 hours of daylight and 12 hours of darkness. Spring begins in the Northern Hemisphere. Fall begins in the Southern Hemisphere.



**2 June solstice**  
The Northern Hemisphere is maximally tilted toward the Sun and experiences the longest day of the year. Summer begins in the Northern Hemisphere. Winter begins in the Southern Hemisphere.

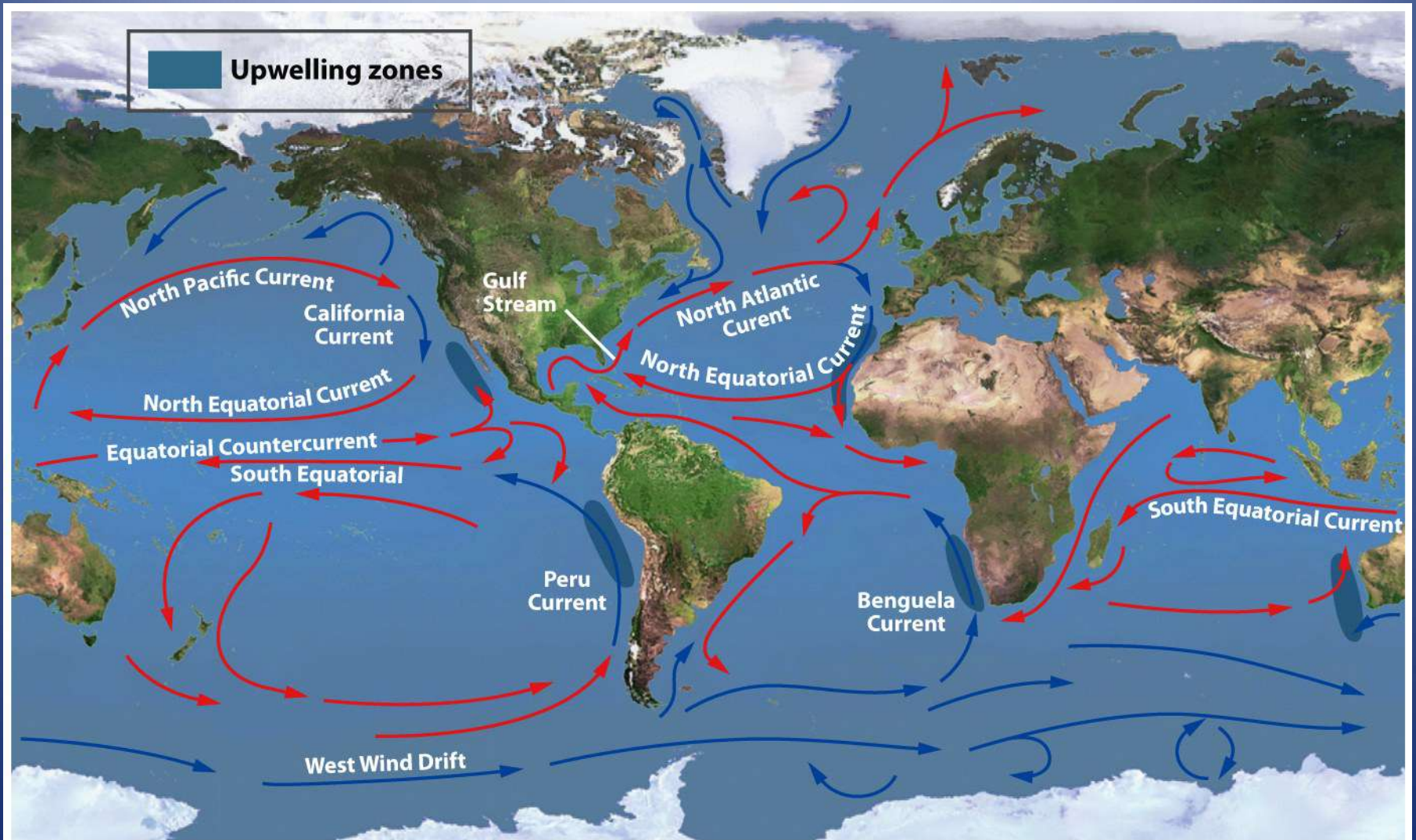
**4 December solstice**  
The Northern Hemisphere is maximally tilted away from the Sun and experiences the shortest day of the year. Winter begins in the Northern Hemisphere. Summer begins in the Southern Hemisphere.

**3 September equinox**  
The Sun is directly overhead at the equator and all regions of Earth receive 12 hours of daylight and 12 hours of darkness. Fall begins in the Northern Hemisphere. Spring begins in the Southern Hemisphere.

**Figure 4.10**

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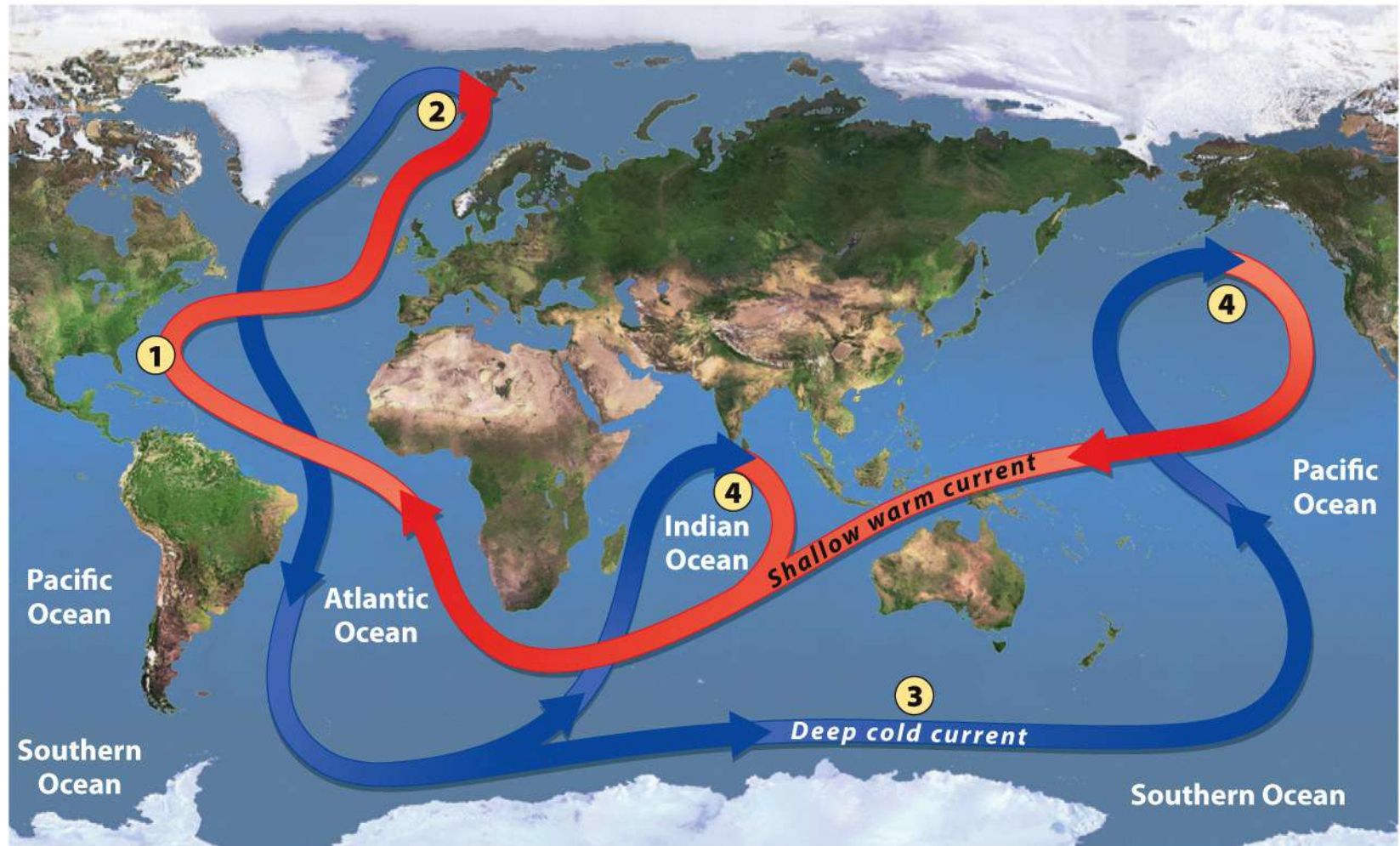


**Figure 4.11**

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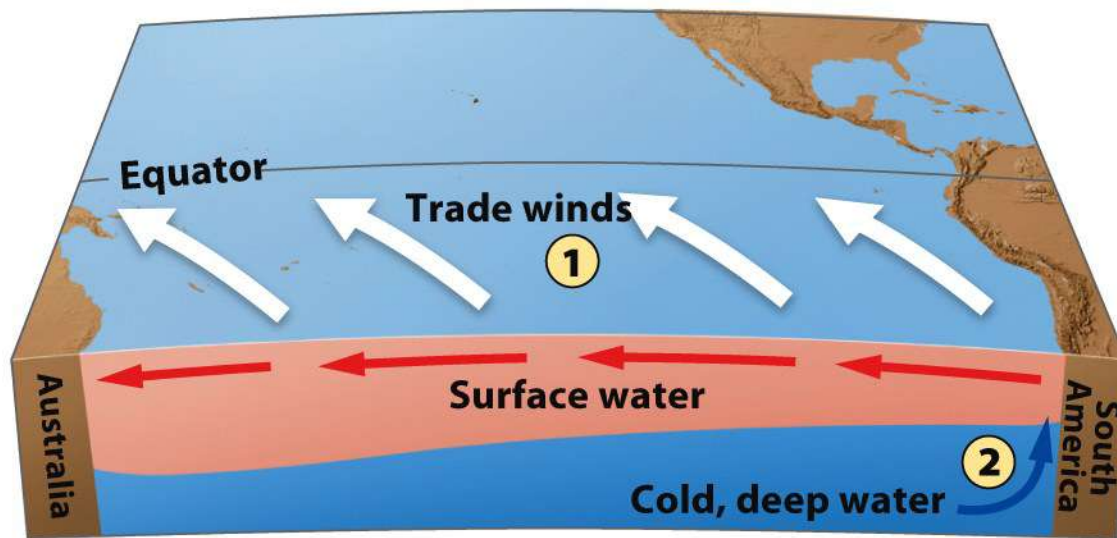
- 1 Warm water flows from the Gulf of Mexico to the North Atlantic, where some of it freezes and evaporates.
- 2 The remaining water, now saltier and denser, sinks to the ocean bottom.
- 3 The cold water travels along the ocean floor, connecting the world's oceans.
- 4 The cold, deep water eventually rises to the surface and circulates back to the North Atlantic.



**Figure 4.12**

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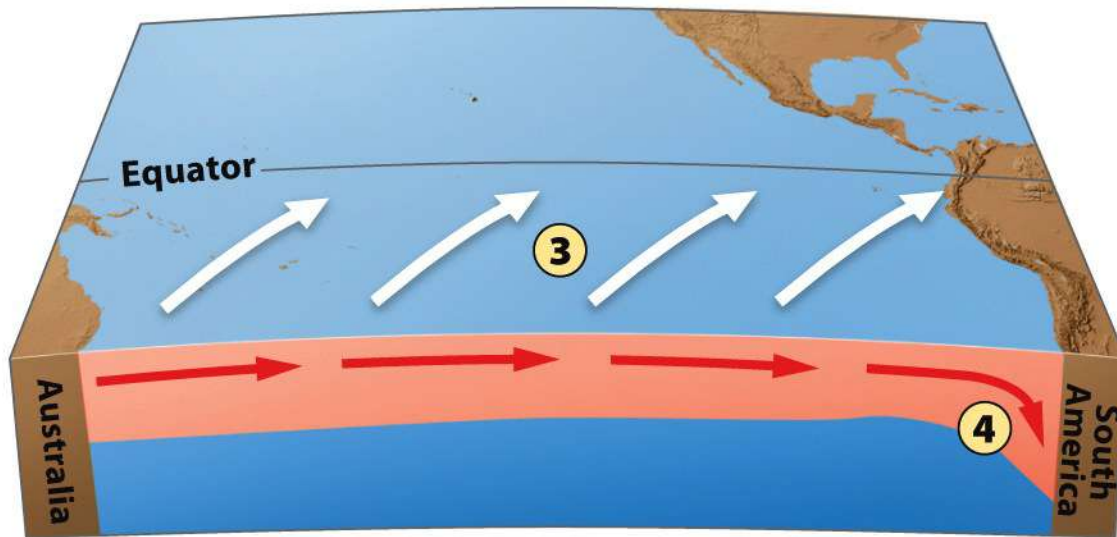
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**1** During most years, trade winds push surface water from east to west.

**2** Deep water moves upward (upwelling) to replace surface water that has moved westward.

**(a) Normal year**



**3** During El Niño years, trade winds weaken or reverse direction; warm surface water moves from west to east.

**4** The warm surface water builds up along the coast of South America and prevents upwelling of the deep cold water.

**(b) El Niño year**

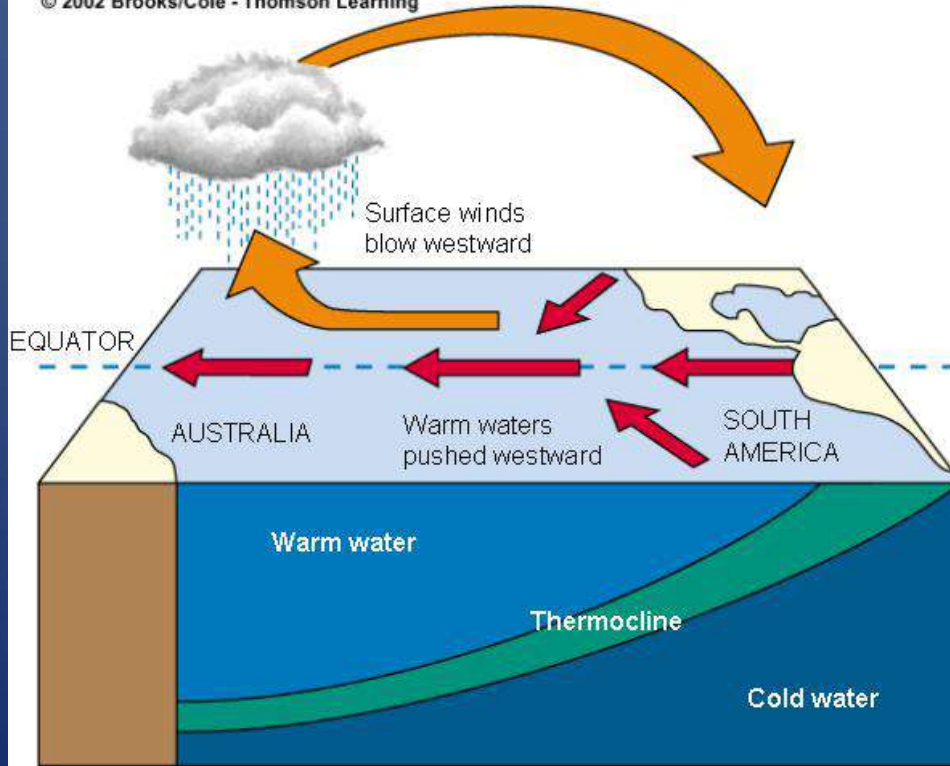
**Figure 4.13**

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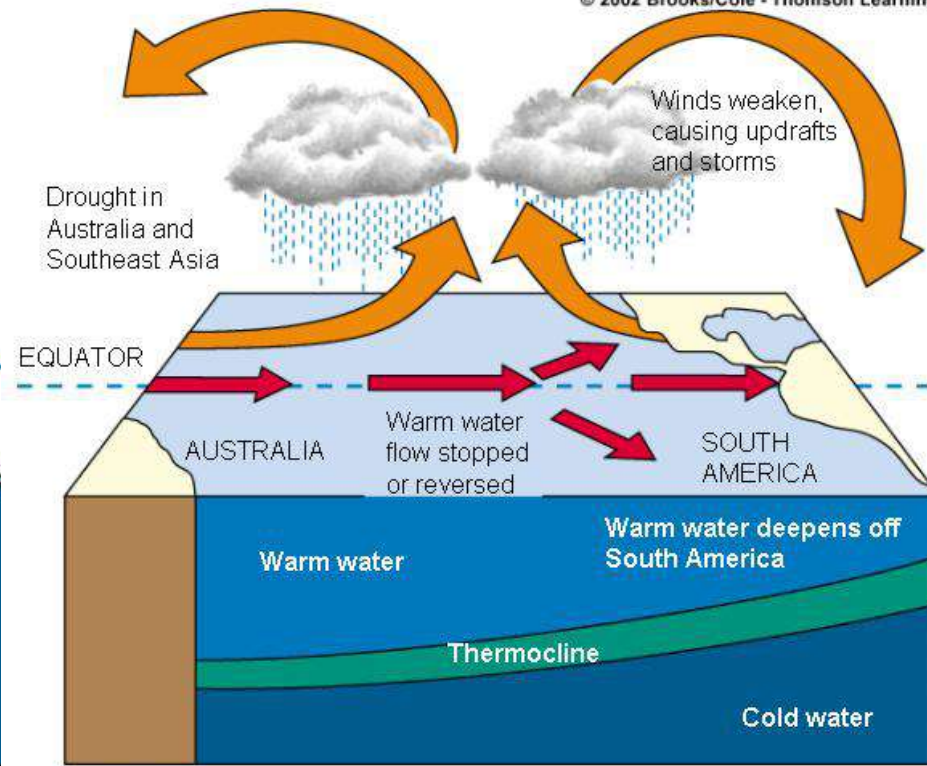
# ENSO

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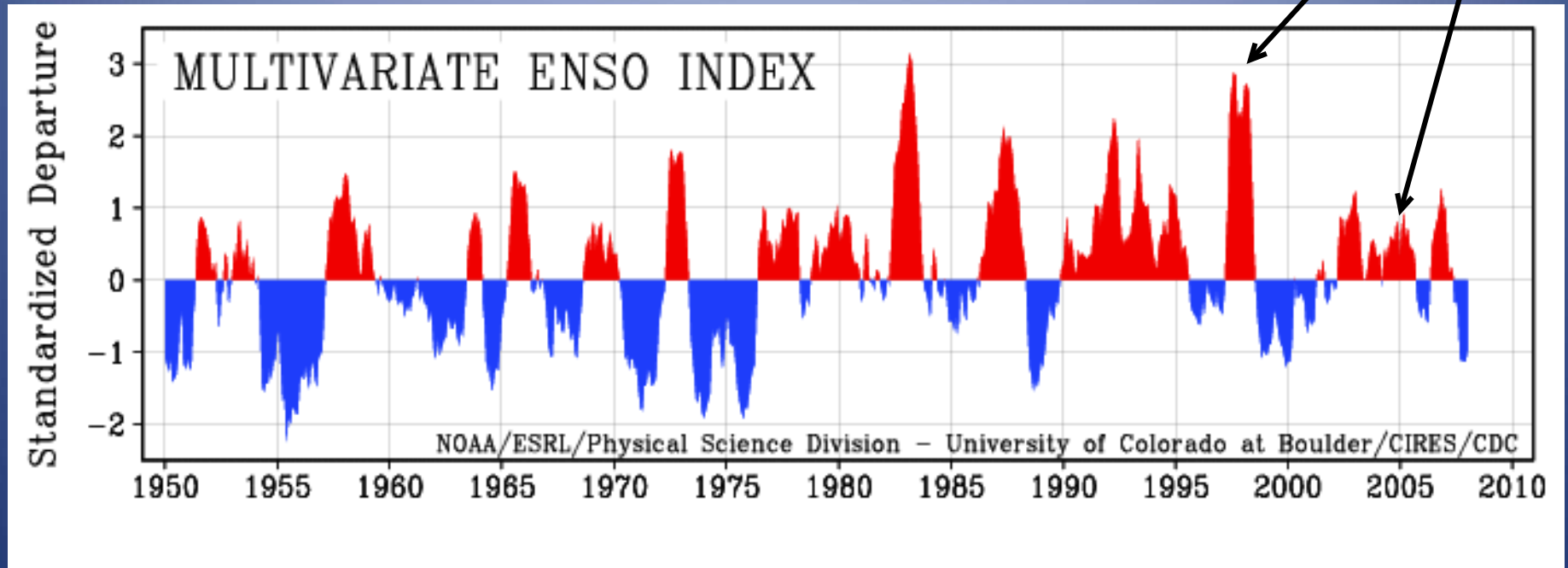
Normal Conditions

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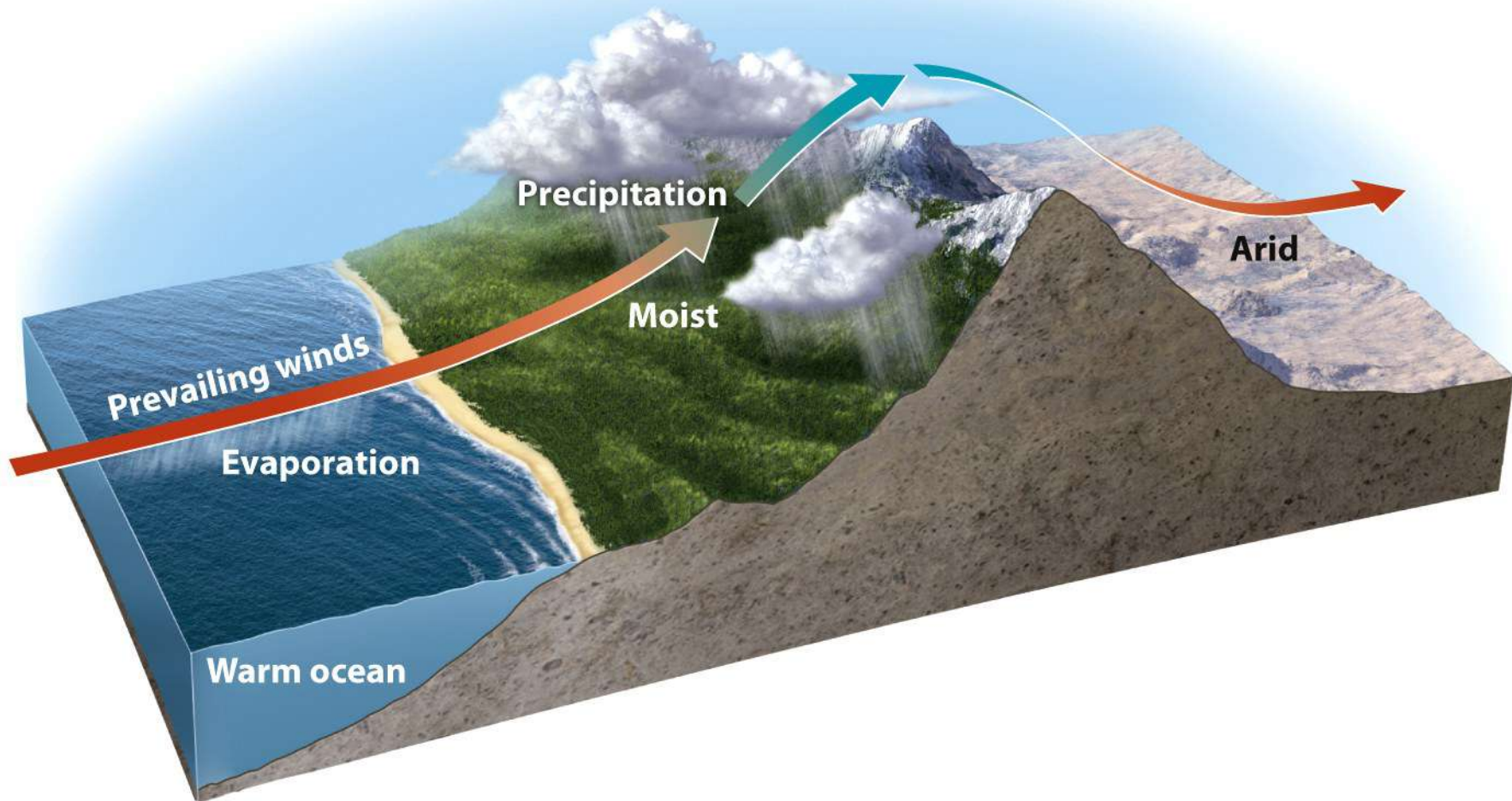


El Niño Conditions

# Effects of ENSO



2014  
1998  
2010 & 2013  
2005



**Figure 4.14**

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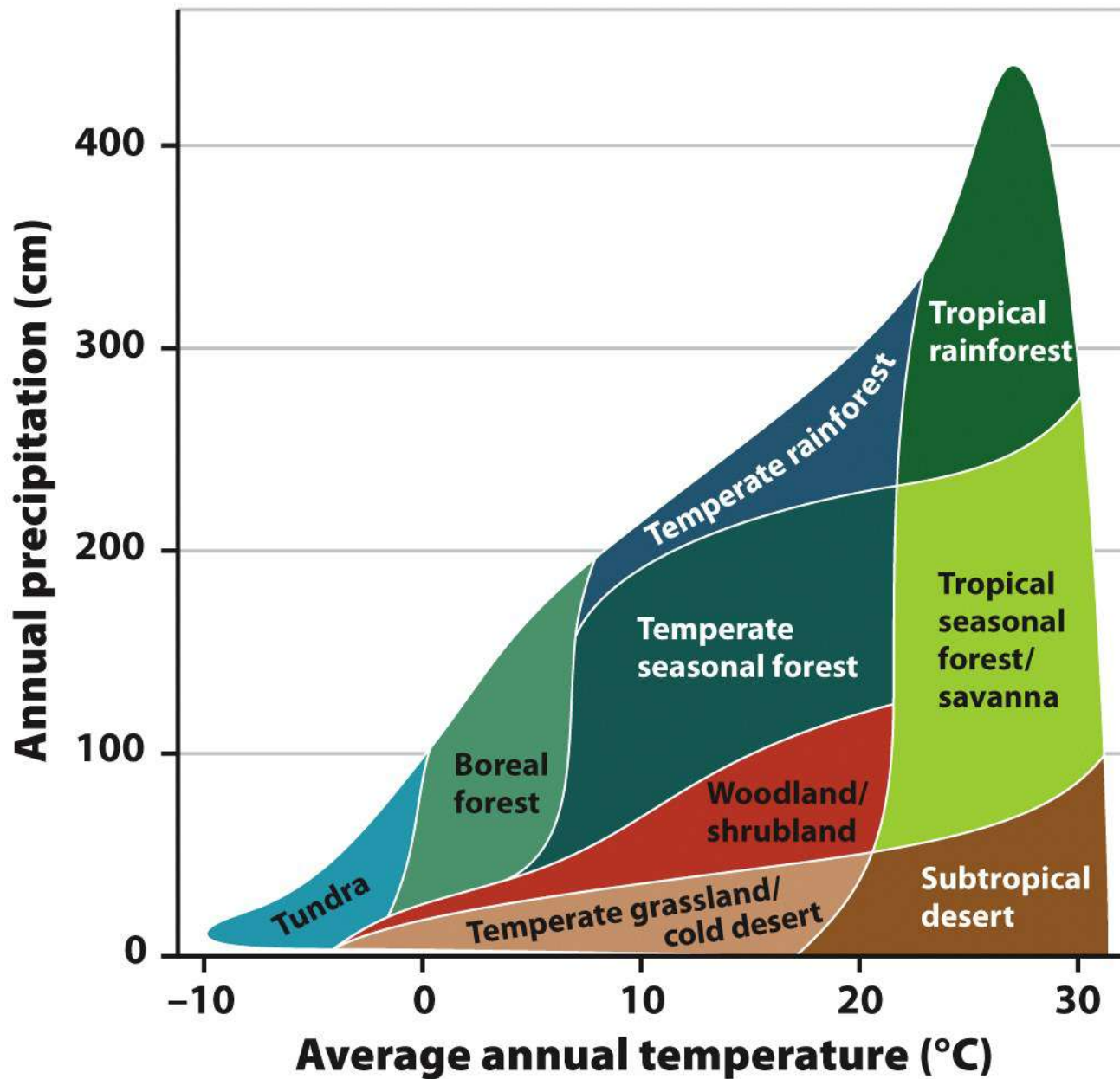
**Figure 4.15a**  
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**Figure 4.15b**  
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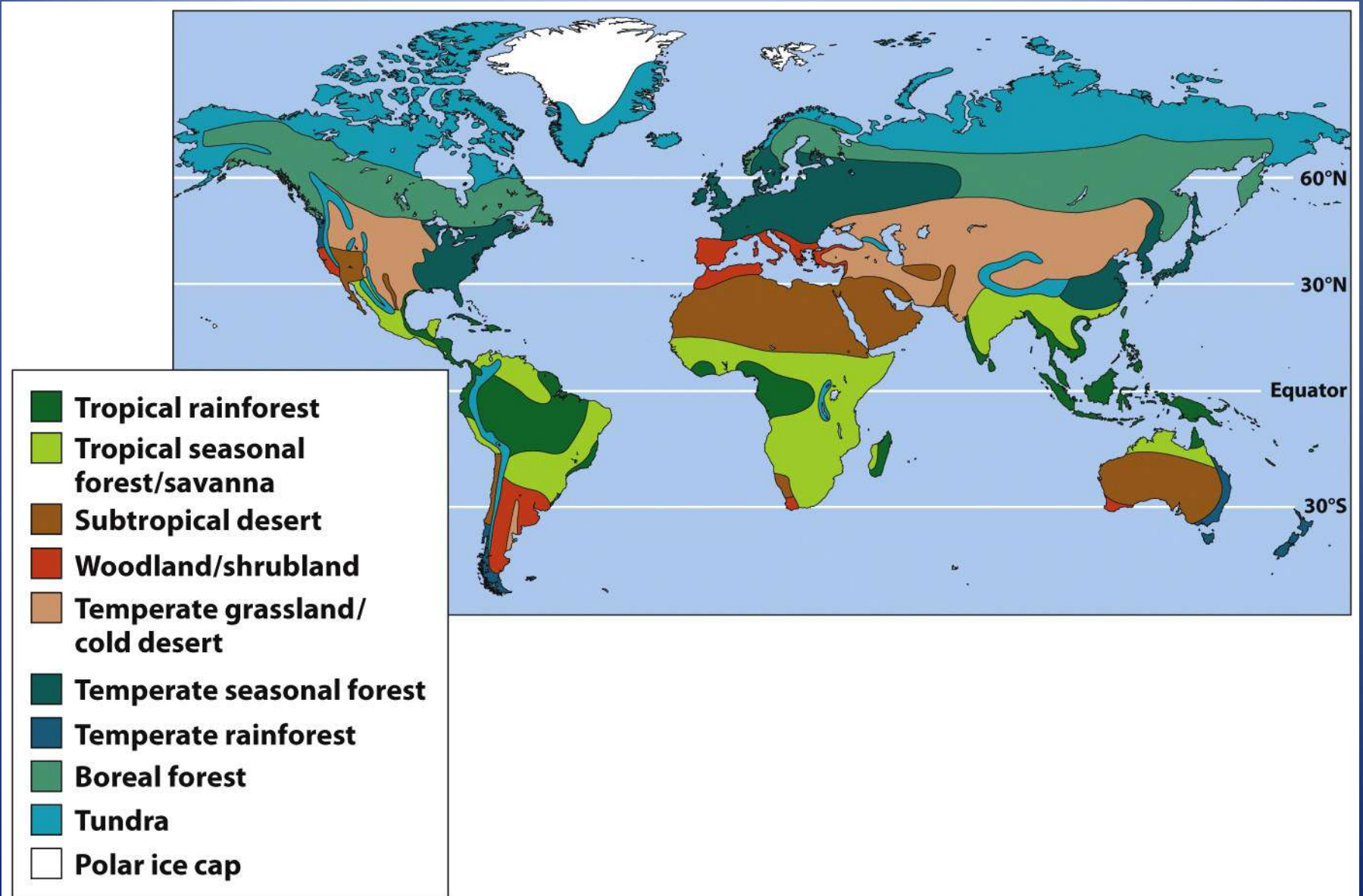
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**Figure 4.16**

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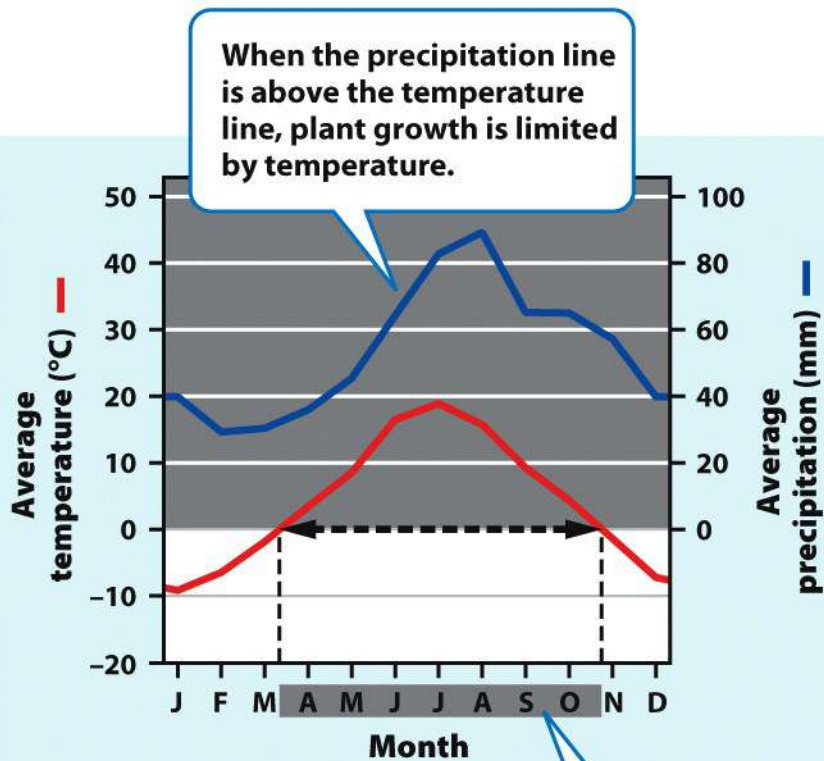
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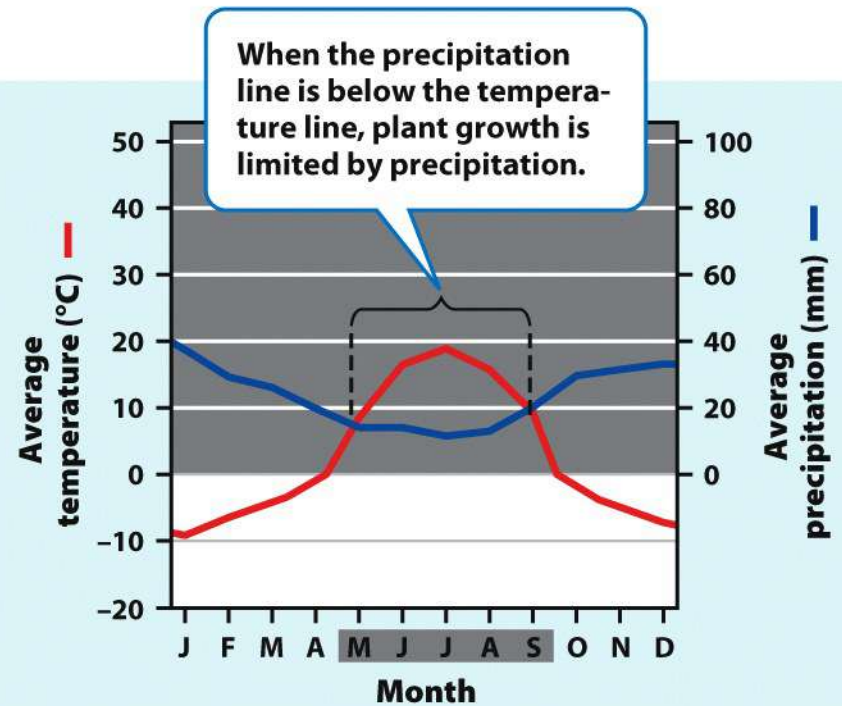
**Figure 4.17**

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(a) Example 1



(b) Example 2

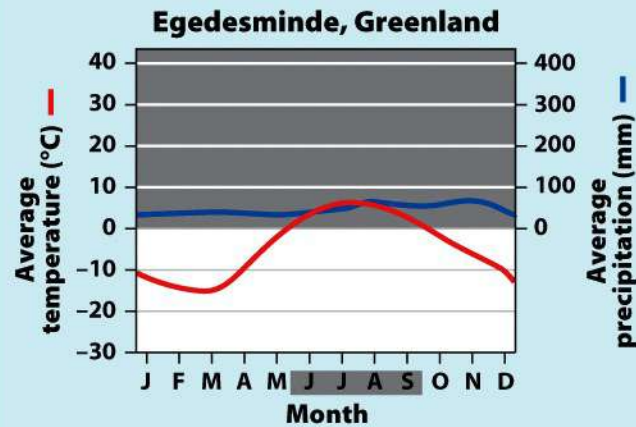
Shaded region indicates the growing season, when temperatures are above 0°C.

Figure 4.18

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# Tundra

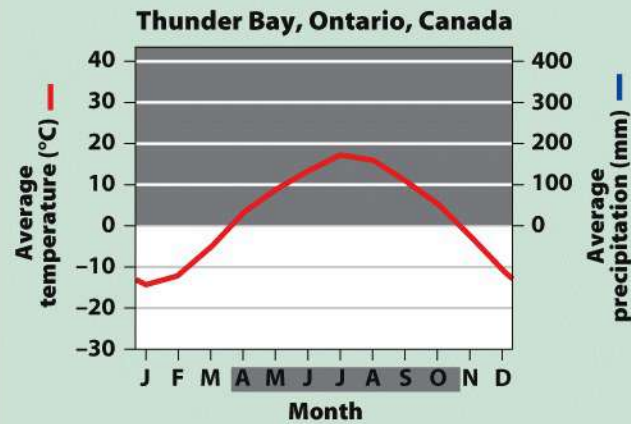


**Figure 4.19**

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# Taiga



**Figure 4.20**

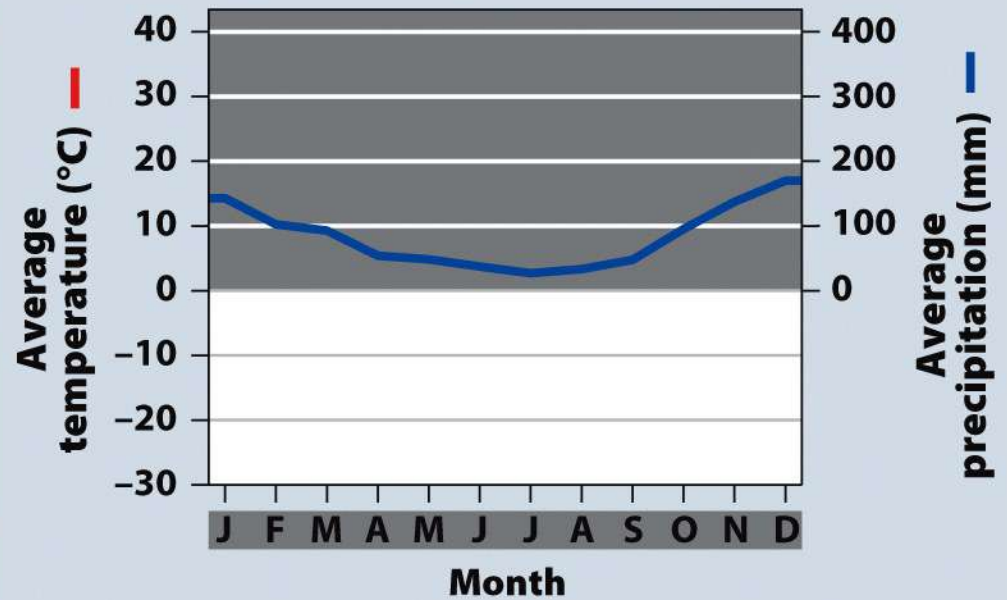
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# Temperate Rainforest



**Nanaimo Departure Bay, British Columbia, Canada**



**Figure 4.21**

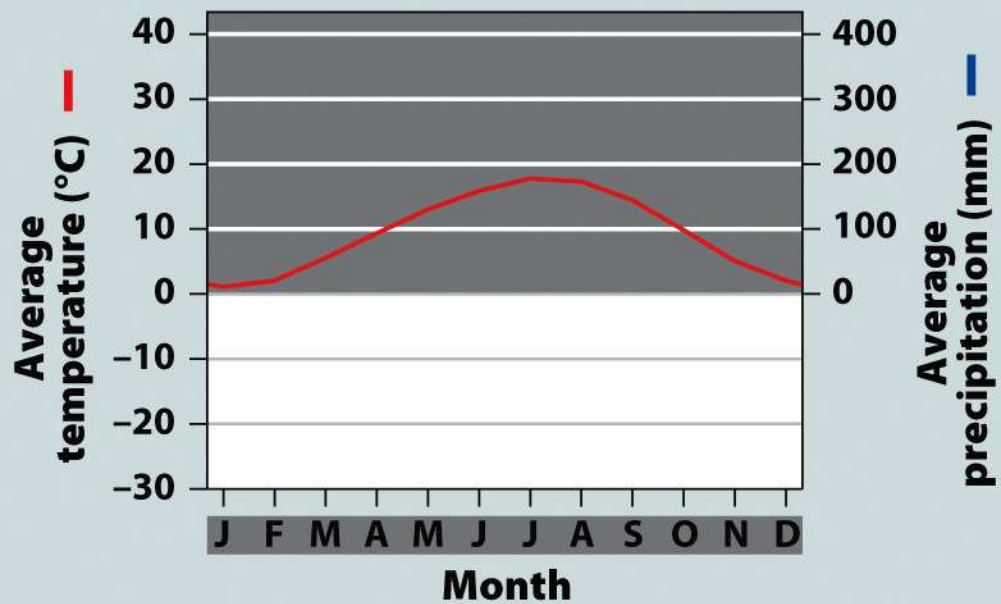
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# Temperate Seasonal Forest



**Stuttgart, Germany**



**Figure 4.22**

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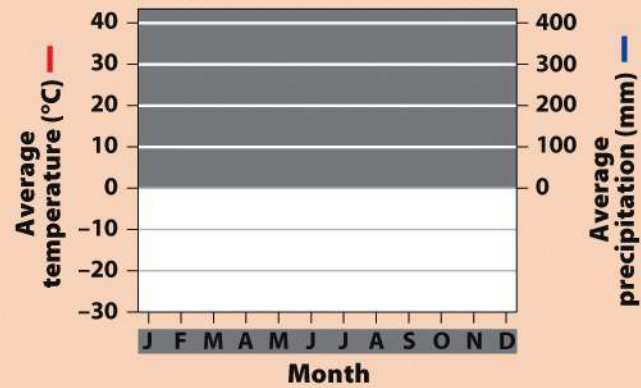
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# Chaparral



**San Luis Obispo, California, United States**

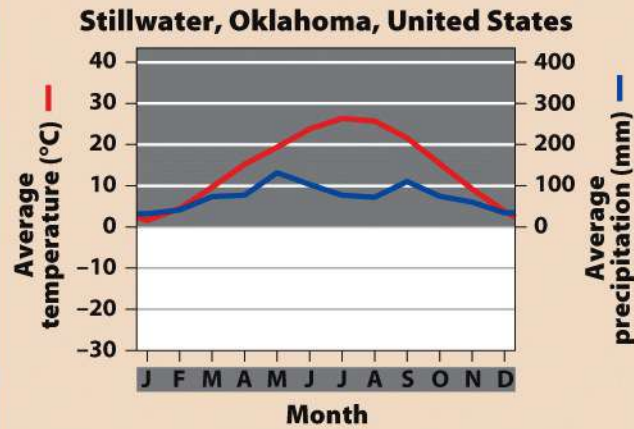


**Figure 4.23**

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# Temperate Grassland

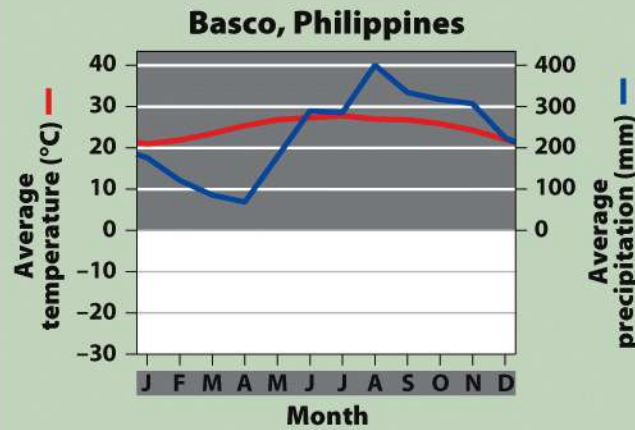


**Figure 4.24**

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# Tropical Rainforest

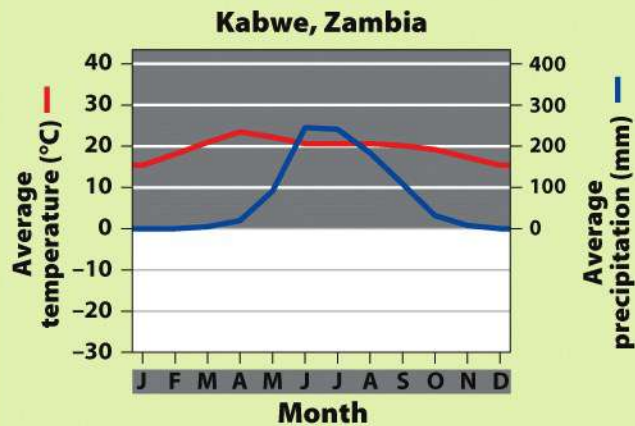


**Figure 4.25**

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# Tropical Seasonal Forest & Savannah



**Figure 4.26**

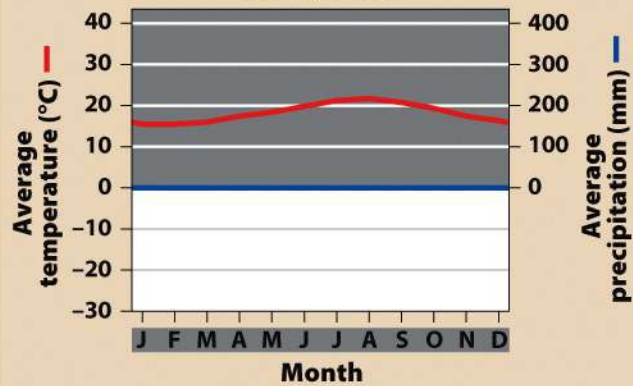
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# Subtropical Desert



**Arica, Chile**

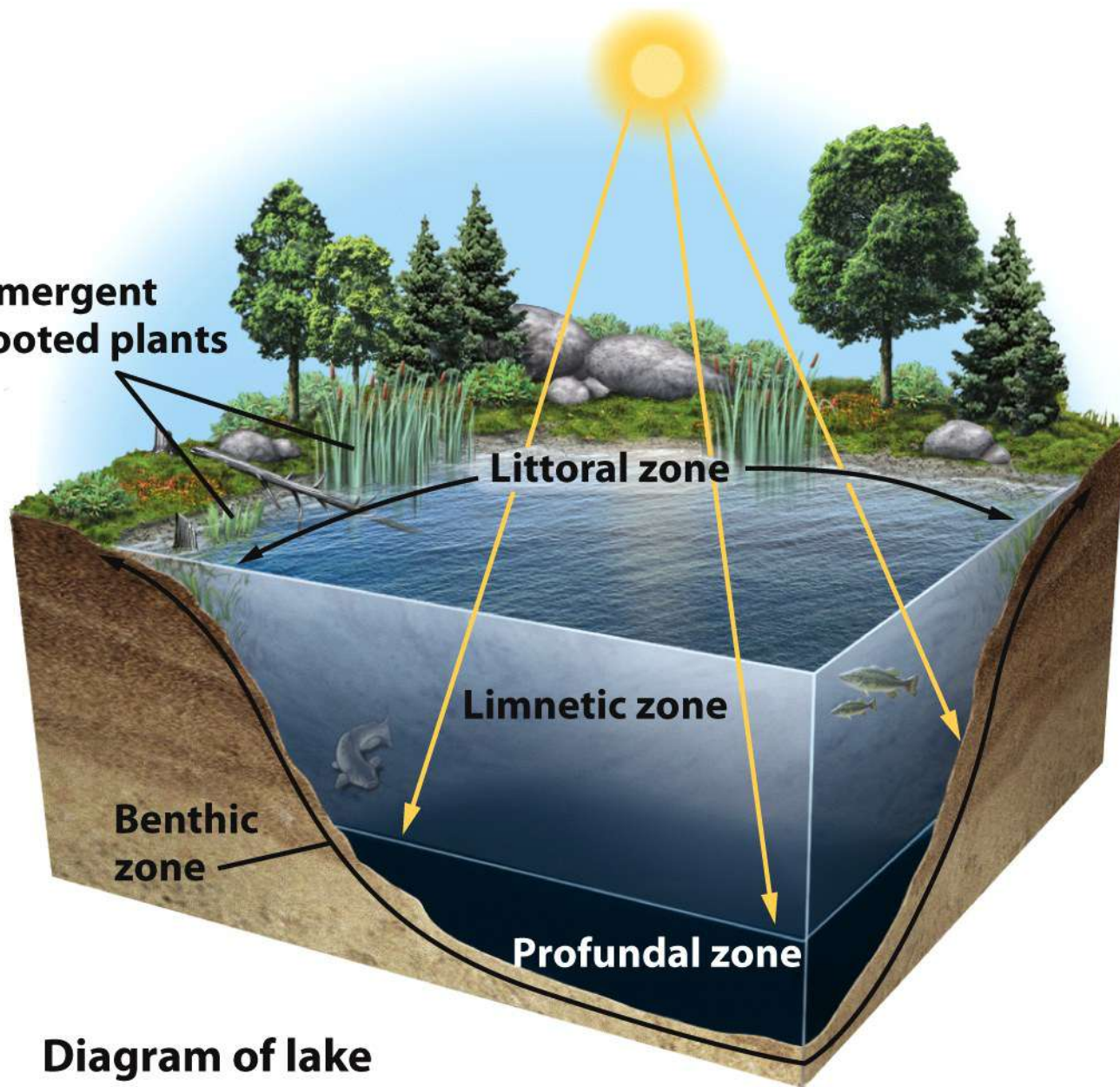


**Figure 4.27**

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**Emergent  
rooted plants**

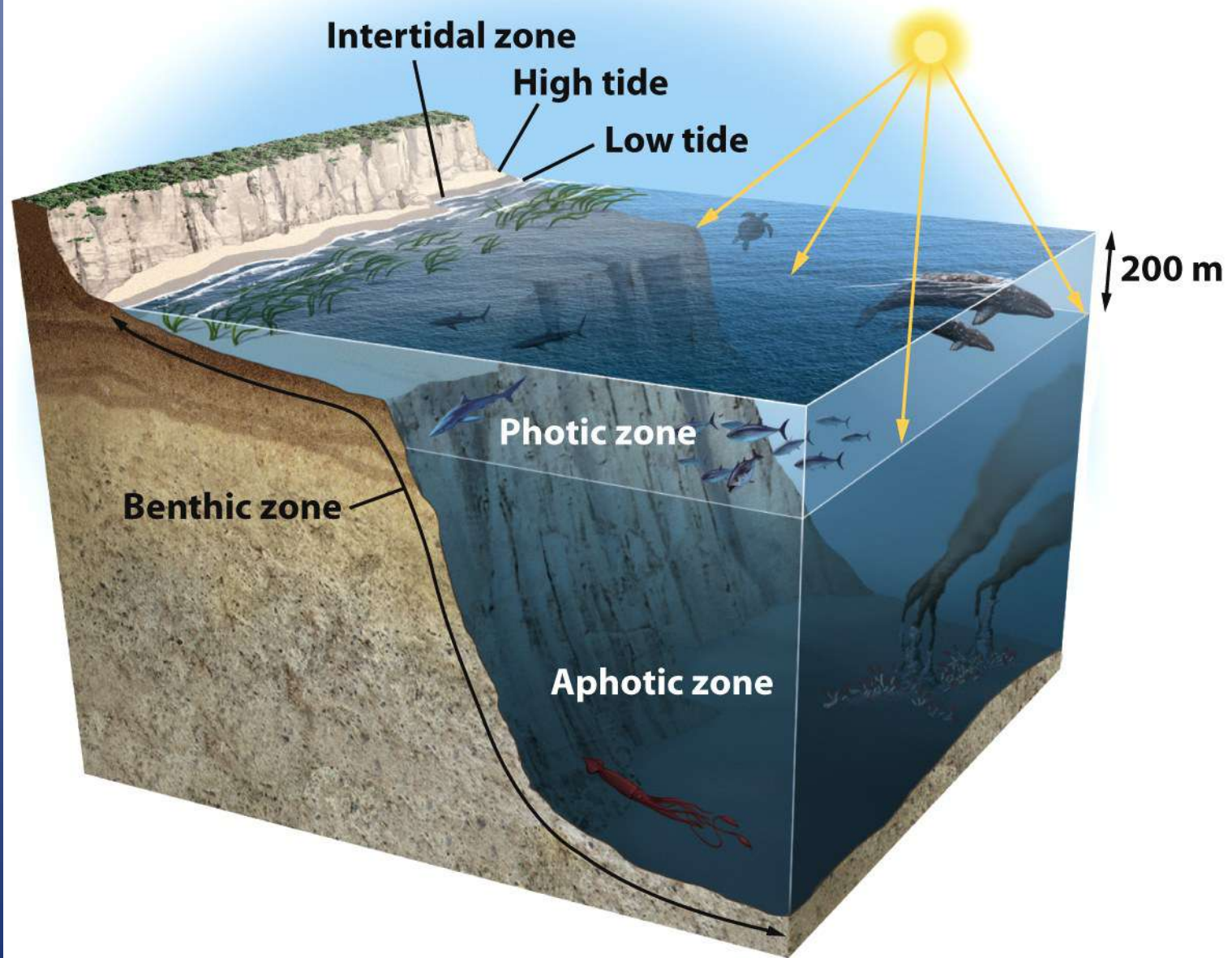


## **Diagram of lake**

**Figure 4.29b**

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**Figure 4.36**  
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