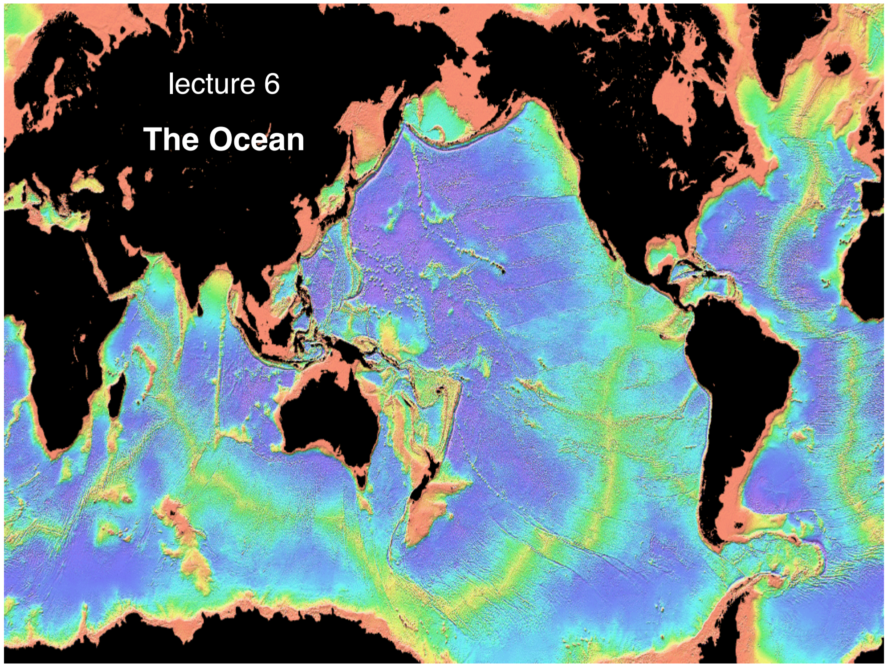
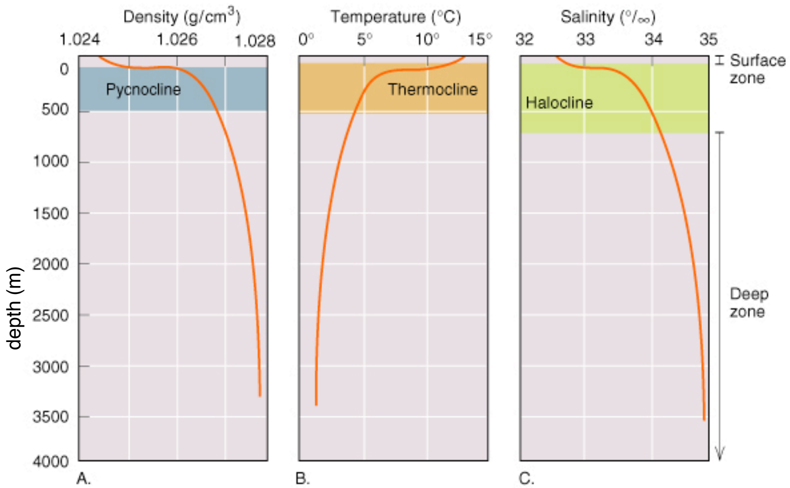


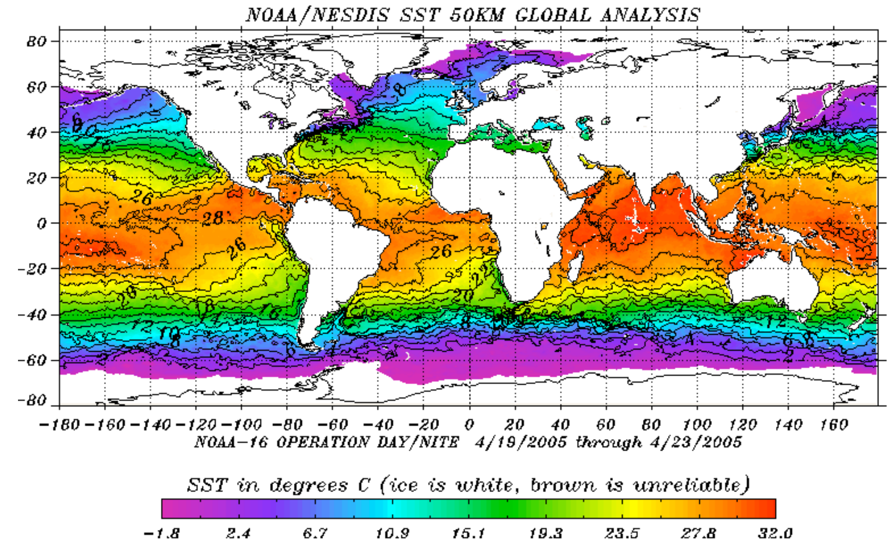
The ocean circulation is driven by the transfer of heat, water, and momentum across the air-sea interface. Heat transfer is accomplished through (1) latent heat flux, (2) sensible heat flux and (3) radiation. Water transfer is accomplished through evaporation and precipitation. And momentum transfer takes place through the frictional effects of winds on the ocean surface.

Temperature, salinity, and density are the key variables describing the state of the ocean. Density is a function of both temperature and salinity. As water warms, it expands and becomes less dense. Dissolved salts are heavier than water, so density increases with salinity.

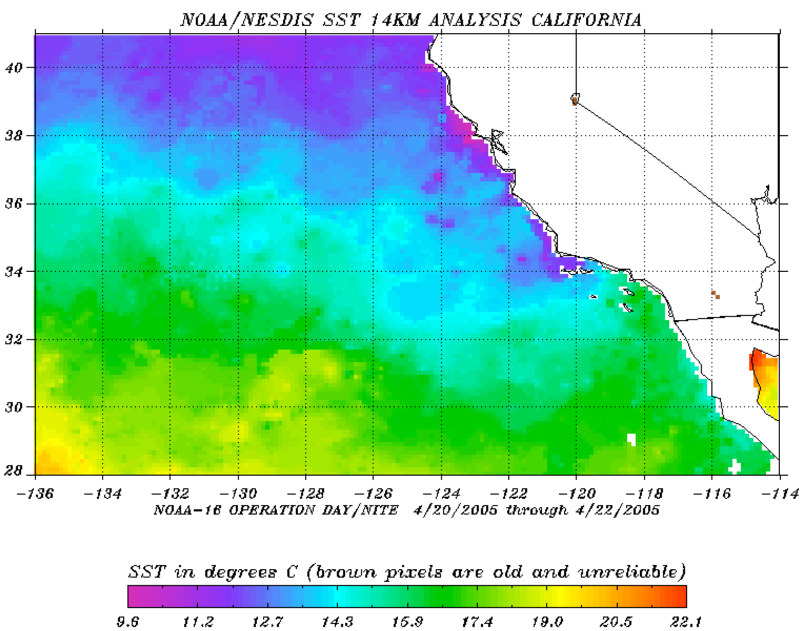
Unlike the atmosphere, the ocean is heated from above. Therefore, the warmest temperatures are at the surface of the ocean. Because warmer water is lighter, this creates a stable environment, with little vertical motion. This is why the deep circulation of the ocean is so sluggish compared to the atmosphere.

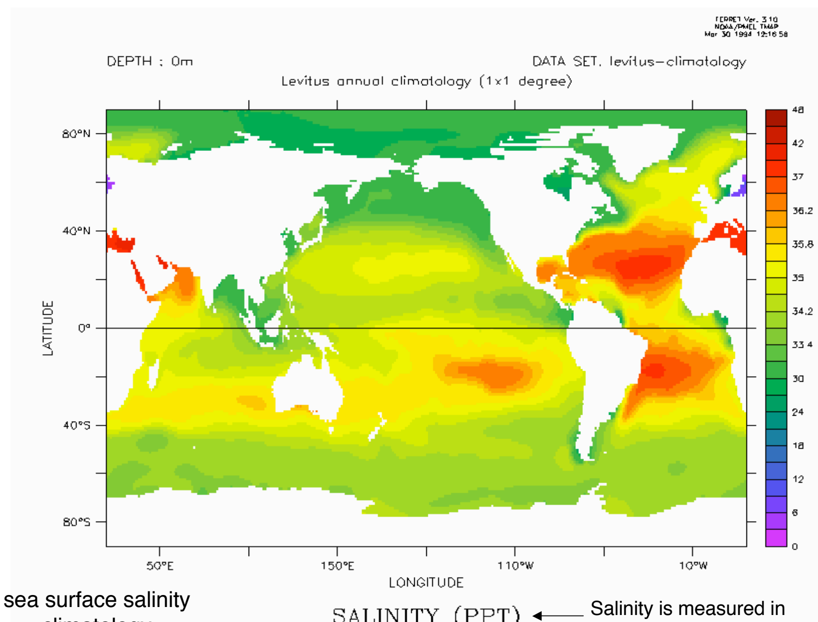
Vertical distribution of temperature, salinity, and density





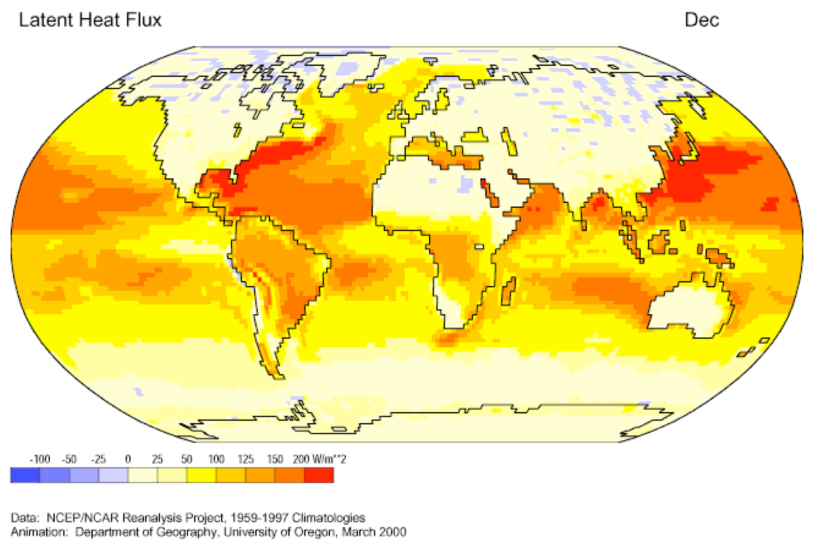
A snapshot of recent sea surface temperatures

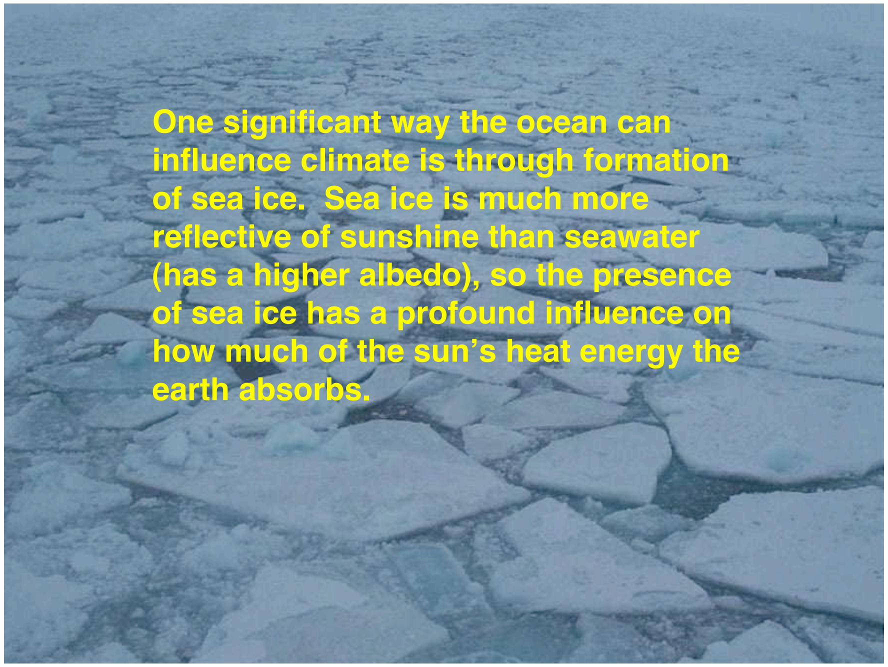




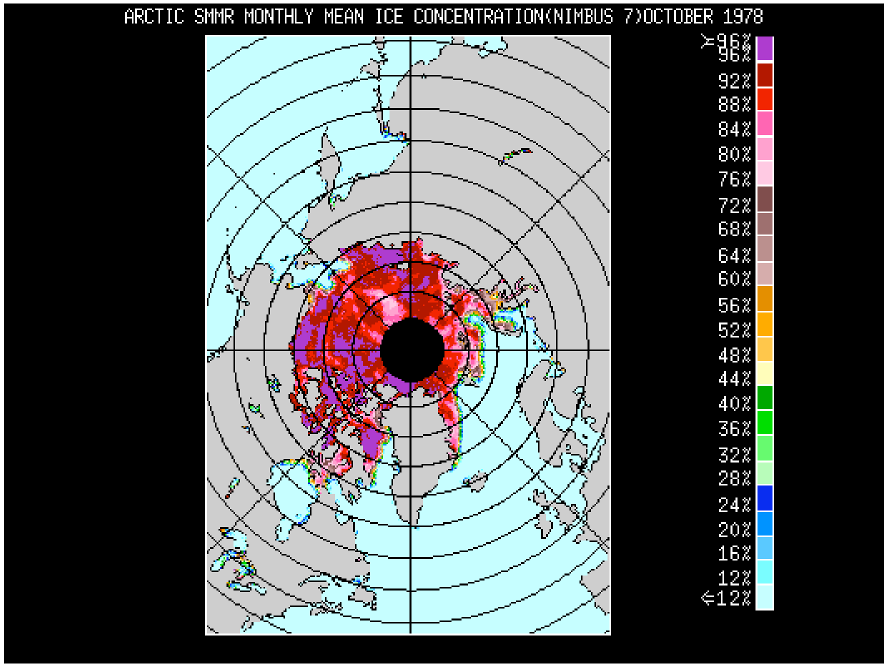
sea surface salinity climatology

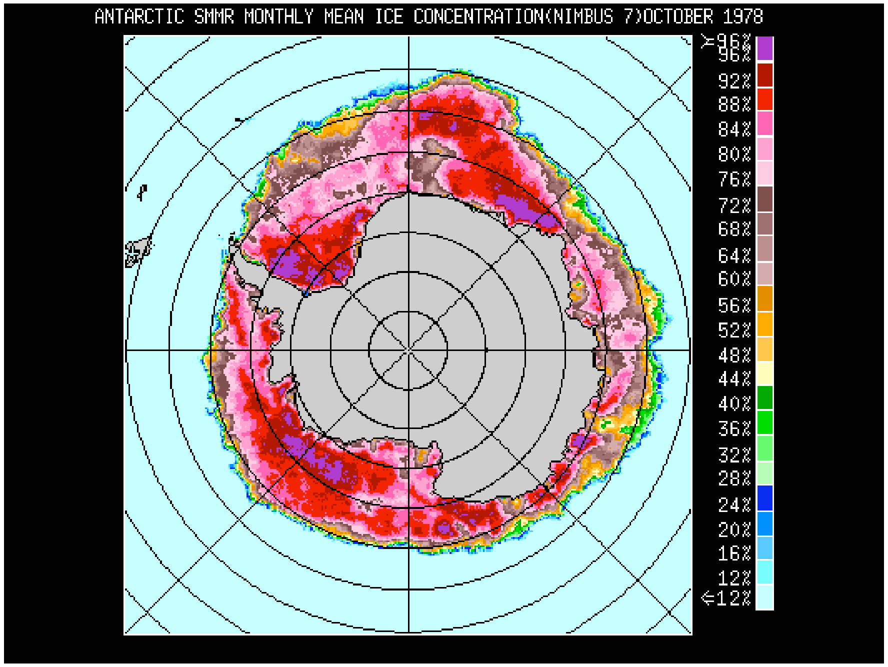
Salinity is measured in parts per thousand

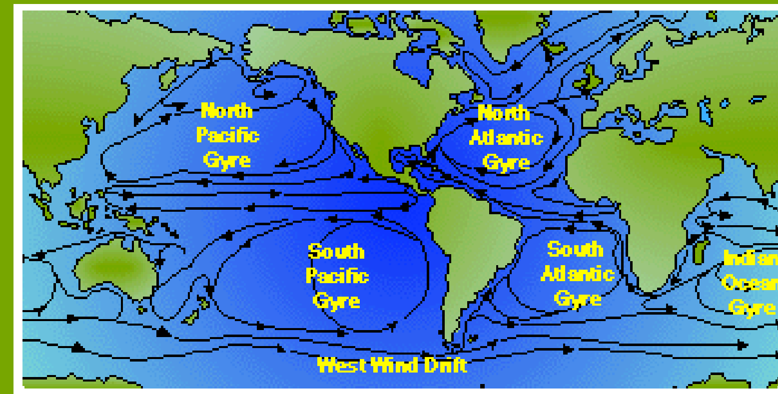

Latent Heat Flux
Dec
-100 -50 -25 0 25 50 100 125 150 200 W/m**2
Data: NCEP/NCAR Reanalysis Project, 1959-1997 Climatologies
Animation: Department of Geography, University of Oregon, March 2000


One significant way the ocean can influence climate is through formation of sea ice. Sea ice is much more reflective of sunshine than seawater (has a higher albedo), so the presence of sea ice has a profound influence on how much of the sun's heat energy the earth absorbs.

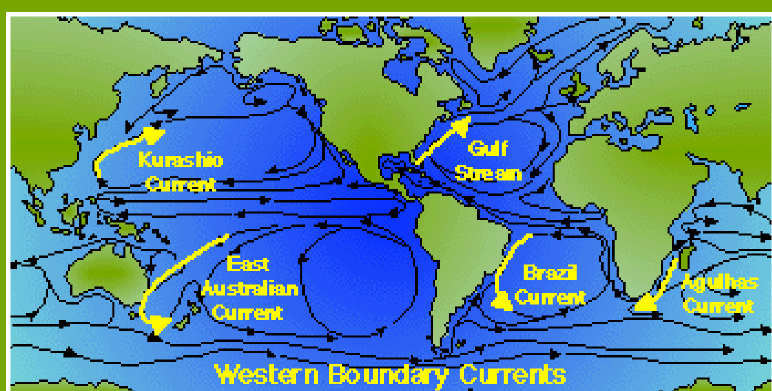

Sea ice extent is closely linked to temperature, and exhibits a pronounced seasonal cycle in both hemispheres. Sea ice covers the largest area in late winter, and the smallest area in late summer.


ARCTIC SMMR MONTHLY MEAN ICE CONCENTRATION(NIMBUS 7)OCTOBER 1978
>96%
96%
92%
88%
84%
80%
76%
72%
68%
64%
60%
56%
52%
48%
44%
40%
36%
32%
28%
24%
20%
16%
12%
<12%

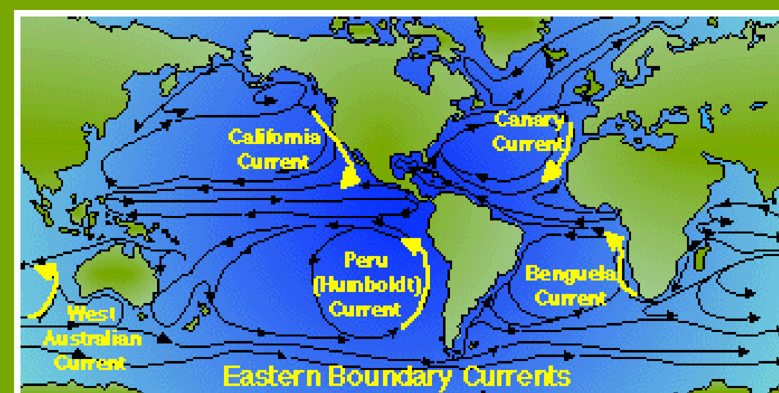




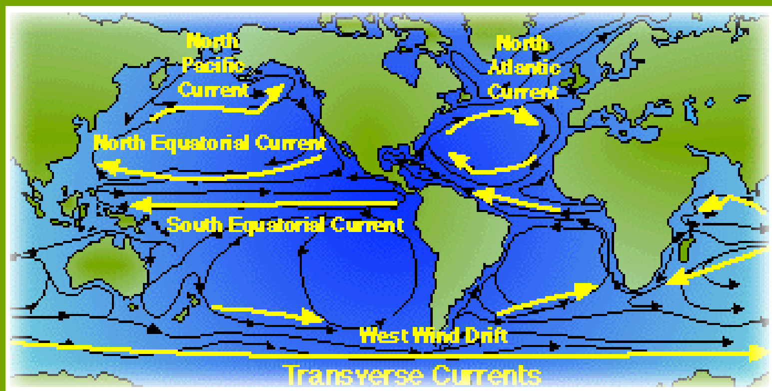
The surface ocean currents of the Pacific and Atlantic basins are organized into circulating patterns known as gyres, one on each side of the equator. A gyre also exists in the Indian Ocean. The gyres rotate clockwise in the northern hemisphere, and counterclockwise in the southern hemisphere.



On the western side of the ocean basins, relatively strong currents known as western boundary currents transport warm water poleward. The Gulf Stream along the Atlantic coast is a well-known example of a western boundary current.

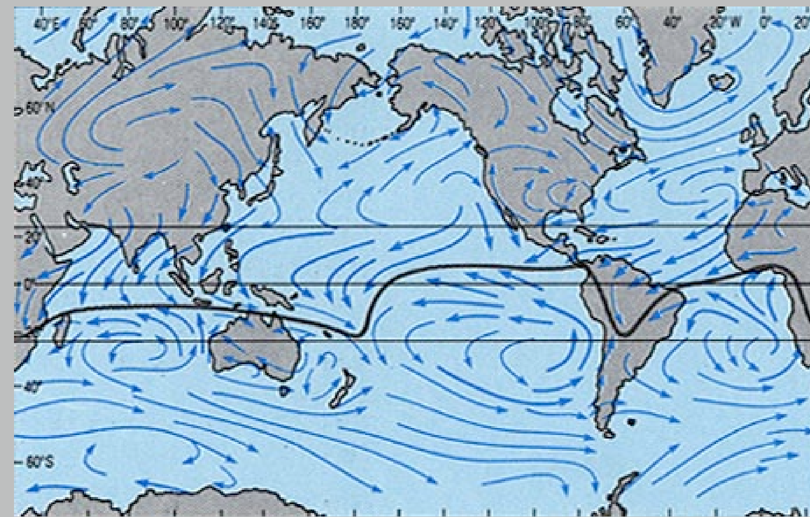


On the eastern side of ocean basins, relatively weak currents transport cold water toward the equator. These are known as eastern boundary currents. One of these currents, the California Current is the reason why the waters off our coast are relatively cold.



East-west transverse currents complete the gyres. The Southern ocean presents a unique case. These are the only latitudes of the world without any land. As a result of the large temperature contrast between the cold waters surrounding Antarctica and the warm waters of the Pacific and Atlantic, an intense eastward circumpolar current forms here.

Climatological Surface Winds



The ocean is set in motion by the atmosphere. Surface winds generate ocean currents. To see how this occurs, we first need to understand the concept of Ekman drift.

Ekman drift refers to the mechanical response of the ocean to wind blowing across its surface. The surface water is dragged along with the wind. However, due to the Coriolis force, it is deflected somewhat to the right (in the NH). The surface water drags along the water immediately beneath it but at a somewhat slower speed, and this layer is also deflected to the right under the influence of the Coriolis force. The result is a spiraling pattern in the current direction with ever decreasing current speeds with depth. **The net transport of water is to the right of the wind.**