Energy Balance and Circulation Systems
Ocean circulation

Source: NOAA
Atmospheric Circulations

The Energy to Drive the Atmosphere

Unequal distribution in incoming solar radiation (red) and outgoing Earth’s radiation (blue)

Weather patterns and ocean currents redistribute energy from latitudes with a surplus into latitudes with a deficit.

Energy received at the surface depends on:

1) Sun angle with respect to surface.
2) Path of solar radiation through the atmosphere.

Solar Radiation Entering the Atmosphere

• Absorbed by gases and clouds – goes to heating (19%)
• Scattered and Reflected by **Gas Molecules, Clouds, Aerosols, and the Earth’s surface** (30%)

Earth’s Energy Balance

Earth’s overall average equilibrium temperature changes only slightly from year to year.

A balance exists between incoming solar energy (shortwave radiation) and outgoing energy from Earth to space (longwave radiation).

Without greenhouse gases, the average surface temperature of the Earth would be $-18^\circ C$.

- **No greenhouse gases** (only permanent gases)
- **The current atmosphere** (with greenhouse gases)
