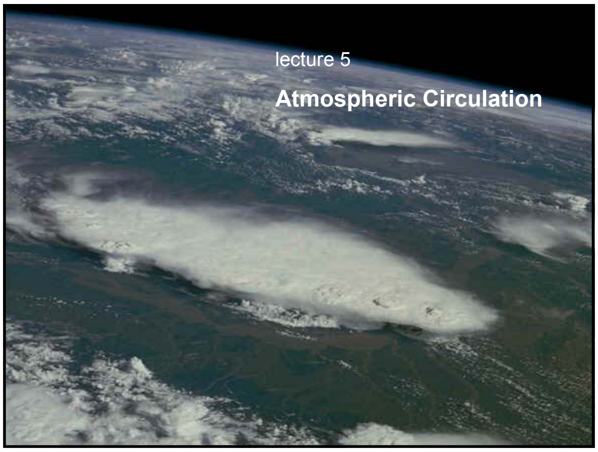
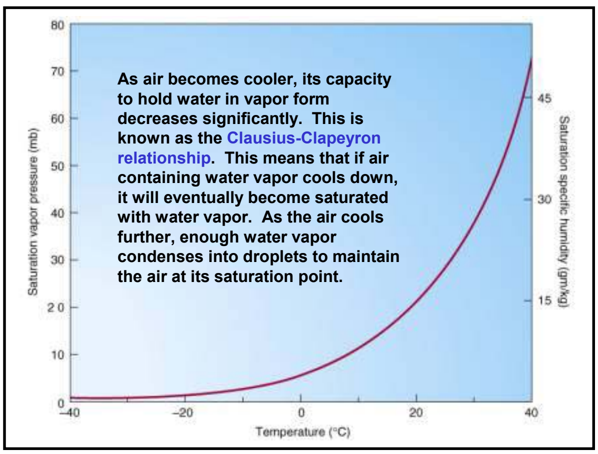
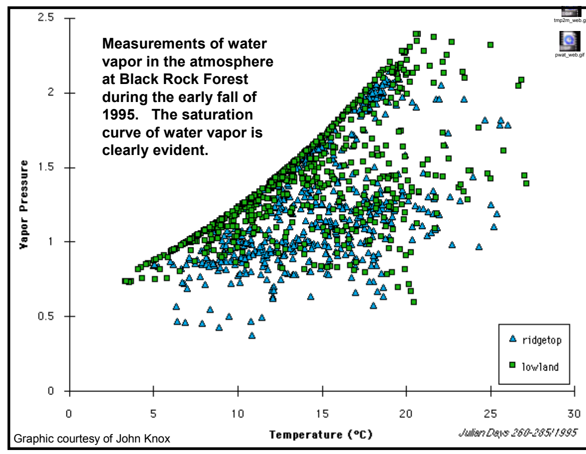
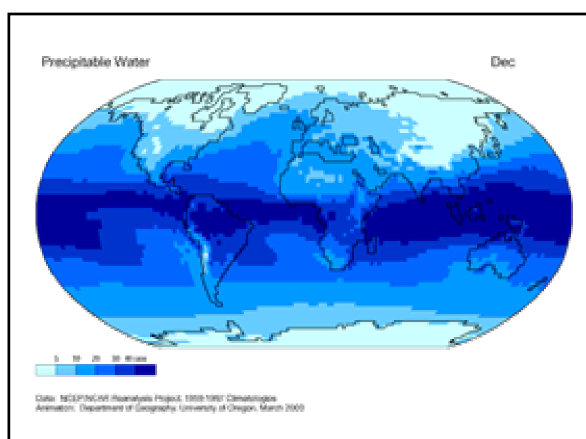


There is one final concept to understand before we piece together our understanding of the atmospheric circulation...

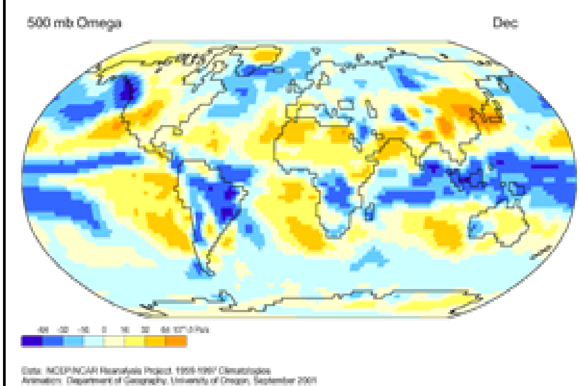




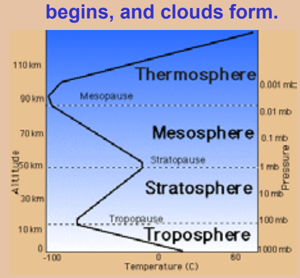
The Clausius-Clapeyron relationship leads us to the concept of relative humidity. **Relative humidity** is defined as the ratio of the amount of water vapor in the air to the amount of water vapor that air would hold if it were saturated. So completely saturated air has a relative humidity of 100%. If the air has half as much water vapor as it can hold, the relative humidity is 50%.



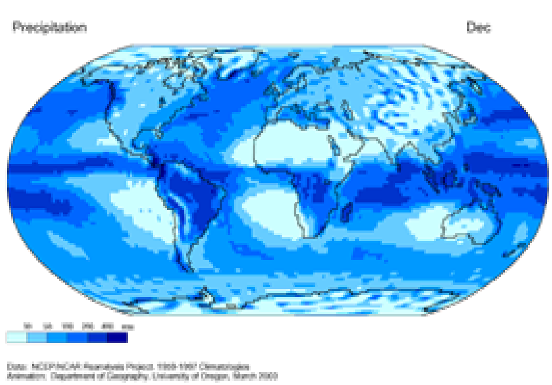
Temperature differences are key in driving the global atmospheric circulation. Warm air tends to rise because it is light, while cold air tends to sink because it is dense. This sets the atmosphere in motion. The tropical circulation is a good example of this.

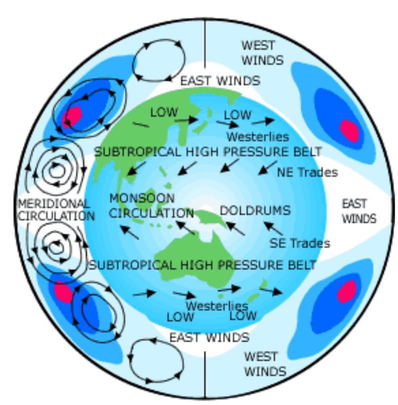


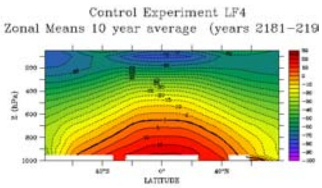
In the lowest 10 km of the atmosphere, temperature decreases with height. So when warm air rises from the surface, it cools. Because of the Clausius-Clapeyron relationship, this often means that the air is quickly brought to saturation. Condensation begins, and clouds form.



If the air is especially buoyant, condensation continues, causing the water droplets to increase in size. Eventually the water droplets are so large they begin to coalesce and fall as precipitation. For this reason, rising motion is often associated with precipitation.



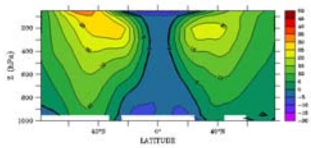




Simulated temperature structure

These plots come from a **computer simulation** of the earth's atmosphere. This simulation is quite realistic in temperature and east-west wind structure.

Simulated structure of east-west winds



Note in both hemispheres the existence of an intense eastward flow in the upper troposphere. These are known as **jet streams**.

The important features of the atmospheric circulation

Inter-tropical convergence zone (ITCZ). The east-west-oriented band of intense convection located over the warmest regions of the tropics.

Sub-tropics. The large areas of sinking, typically located at about 20° latitude, that compensate for the rising motion of the ITCZ. Little precipitation falls in these regions.

Monsoon. A tropical seasonal phenomenon driven by contrasts in land-sea temperature. When the land is warm relative to the ocean, air rises over the land, drawing in moist air from the ocean. Intense precipitation typically follows on land.

Mid-latitude jet stream. An intense air current that moves to the east in both hemispheres. The jet stream is turbulent, particularly in wintertime. The eddies it generates are wintertime storms.

Keep in mind that in our examination of the seasonal variation of surface air temperature, precipitable water, rising motion, and precipitation we've been looking at long-term averages, or climatologies. To get an appreciation for how different the actual weather can look, let's look at day-to-day precipitation variations as viewed from a satellite.

Weather vs Climate

Weather is the short-time-scale (< a few days) evolution of the of the atmosphere.

Climate is the statistics of weather.

Weather prediction. The evolution of the state variables of the atmosphere is governed by nonlinear dynamics (i.e. "chaos"), and is therefore inherently unpredictable beyond a certain period of time.

Climate prediction. There is no reason to doubt the predictability of the statistics of weather.