

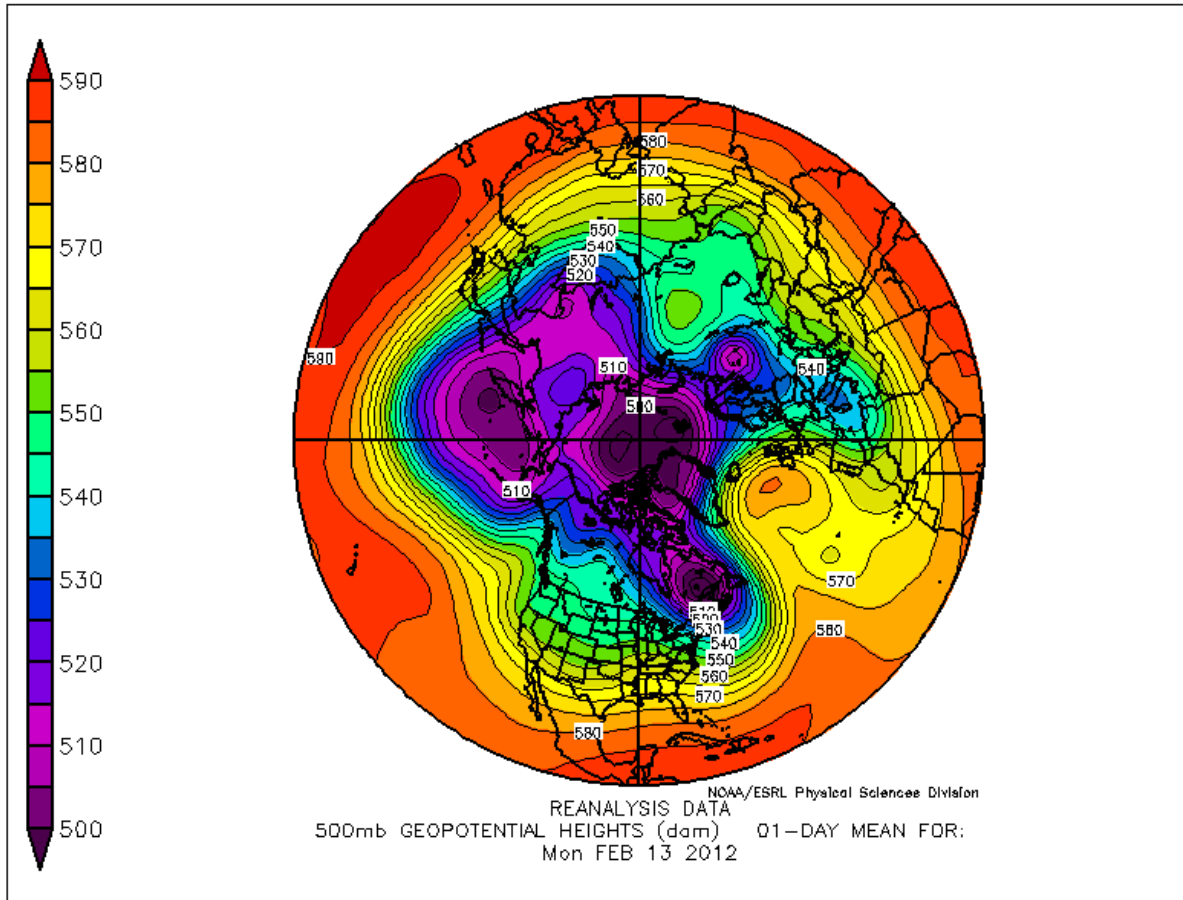
GEOG 401
Climatology

On 500mb Heights

Defined: 500mb (equivalently 500hPa) heights represent the elevation above mean sea level you would have to go to only have approximately half of the atmosphere above you.

Utilities:

- (1) Proxy for mean lower tropospheric temperature:** From the ideal gas law and hydrostatic equation we know that warmer air masses occupy more volume than colder air masses under equal pressure. This means that at the equator you have to climb a taller ladder to get half-way through the atmosphere (by mass) versus at the pole.
- (2) The geostrophic wind blows parallel to isolines of geopotential height.** Away from the boundary layer, the primary forces acting on an air parcel are the pressure gradient force and Coriolis force. When these forces are in harmonious balance (true at large scales outside the tropics), wind speeds are proportional to the gradient in the height field and wind direction is parallel to isolines of height. These winds are often a good proxy for the steering flow of weather systems and the westerlies/stormtrack.



An example:

The map above shows the 500mb height for 13 Feb 2012. The elevation is shown in decameters (meters x 10) above mean sea level. Immediately you will see that the lowest heights are at the pole where air is very cold, whereas highest heights near the subtropics and warmer air mass. A parcel of air 5000m above sea level at 20N has much greater pressure pushing down on it than a parcel at 5000m over the pole. This invokes an equator-to-pole pressure gradient force which is then acted on by the Coriolis force and results in west-to-east flow aloft, or the westerlies. Taking a closer look at the map above you will see big deviations in the zonally symmetric view, these are ridges and troughs, or more generally waves in the midlatitudes that are important in poleward heat and moisture flux, not to mention in terms of bringing “weather” as us “midlatituders” know it. You should note a cold air mass over eastern Canada that has displaced arctic air southward. Due south of that off the east coast of the United States there is a strong South-North gradient in height fields that will drive a strong jet stream in that area. Also, using the geostrophic wind, you should note that the wind direction on the southern tip of Greenland is from the south-southwest and has brought unusually warm air just south of Iceland. These maps are frequently used to predict weather, but are also very useful in explaining climate phenomena.