

**ATM 317**  
Homework 4.2  
Due: 24 April 2019

1. The figure below shows geopotential height at 1000 hPa (red) and 500 hPa (blue). Use a *hand analysis* to draw & label the 1000-500 hPa thickness contours. (e.g.,  $\phi' = \phi_{500} - \phi_{1000}$ )
2. After the thickness field analyzed, *draw arrows*, with appropriate magnitude and direction, to represent the thermal wind in the 1000:500 hPa layer.
3. Use the Sutcliffe-Trenberth form of the QG-omega equation to approximate and *label* regions of both upward and downward vertical motion in the figure below. *Explain* with references to the equation, why you would expect upward and downward motion in the regions you noted.

