Figure 1: The 850 to 400 hPa thickness (m, black) and 850 to 400 hPa average absolute geostrophic vorticity ($x 10^{-5}$ s$^{-1}$, colors).

Figure 2: The 500 hPa geopotential height (m, black) and temperature (°C, red).
**Figure 3**: 400 hPa geopotential height (m, black), temperature (°C, red) and geostrophic wind speed (m s⁻¹, blue). A cross section along the line A-B is shown in Fig. 4.

**Figure 4**: A cross section along the line A-B in Fig. 3, showing potential temperature (K, gray) and geostrophic wind speed (m s⁻¹, blue). The dashed line represents the exact location of the line in Fig. 3.
Using the appropriate figures and your knowledge of the ATM 317 material, you should be able to...

1. Use the Sutcliffe-Trenberth version of the QG-omega equation to identify regions of upward and downward vertical motion in Fig. 1.

2. Draw several Q-vectors in Fig. 2 and identify regions of upward and downward motion.

3. Apply your favorite version of the QG-omega equation to identify the circulations in the jet entrance/exit regions in Fig. 3.

4. Using your analysis of the jet exit region circulation in (3), label regions of expected upward/downward vertical motion in the cross section and determine the sign of the thermal circulation.

5. Describe the contribution of geostrophic temperature advection and geostrophic momentum advection in the jet entrance and exit regions.

6. In Fig. 3, identify regions of positive and negative shear and curvature vorticity.

7. Draw a conceptual diagram based on the cross section that determines the sign of the tilting term in the vorticity equation at the point labeled C.

8. If the surface cyclone is located in the region of strongest column average upward vertical motion, based on your analysis where would you expect the surface low? After evaluating your analysis in questions 1-7, would you expect this surface cyclone to strengthen or weaken?