

ATSC 3032 Homework 2

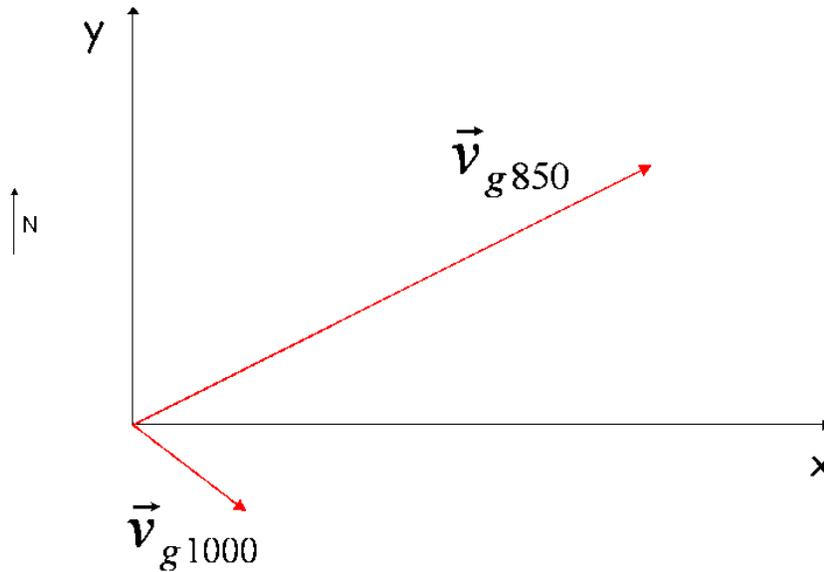
name: _____

due date: Tuesday 19 Feb

worth: 4% of the course grade

1. Temperature advection and the change of wind direction with height (25%)

Shown below is a hodograph, with geostrophic wind vectors at 1000 and at 850 mb.

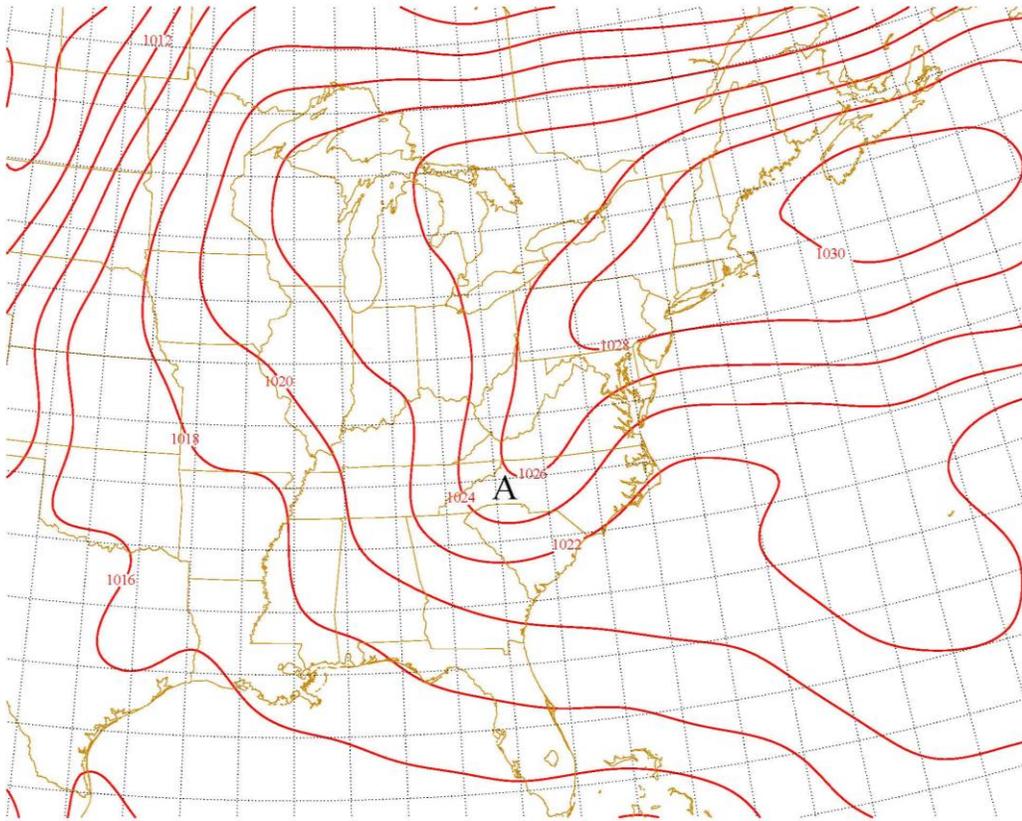


- The wind is _____ (veering/backing) with height, blowing from _____ near sea level (1000 mb) to _____ at 850 mb (indicate wind directions)
- Draw three 1000 mb height contours (or isobars), as thin solid lines (e.g. 30 m, 60 m, and 90 m) and three 850 mb height contours as bold solid lines (e.g. 1500 m, 1530 m, and 1560 m)
- Next, plot the thermal wind vector between 850 and 1000 mb.
- Now draw three isotherms (dashed lines, labelled 0 °C, 5°C, and 10°C), and write "warm" and "cold" in the appropriate regions.
- Next, draw the wind component normal to the isotherms (v_n)
- What is the sign of the temperature advection in the 1000-850 mb layer (WAA or CAA)? (note: feel free to use color lines and a key, for clarity. You can answer b-f on the figure above)

2. Calculate geostrophic wind speed and temperature advection (30%)

- What is the magnitude of the geostrophic wind (v_g) if the height (Z) gradient is 30 m in 300 km and $f=10^{-4} \text{ s}^{-1}$? (hint: $|\vec{v}_g| = \frac{g}{f} |\nabla Z|$)
- Imagine this wind blowing following the passage of a cold front. What is the rate of change of temperature ($\frac{\Delta T}{\Delta t}$) if the wind, mentioned in (a), is aligned with the temperature gradient ($\frac{\Delta T}{\Delta x}$), which is 1K/ 10 km. Show the equation in symbols first. Express this change in units of K (or °C) per hour.

3. problem 8 in chapter 1 of the textbook. (15%)



4. problem 9 in chapter 1 of the textbook. (pressure is shown on the left ordinate, potential temperature lines (red) are labeled on the right ordinate (30%))

