

Homework #5: ATM OCN 718

Assigned: Thursday 12 April 2018

Due: Tuesday 24 April 2018

For this question, you'll need to use two radiosonde profiles that were obtained during a BAMEX field campaign IOP conducted during the overnight hours of 10 June 2003 (the two soundings are available on the course webpage). One profile was taken ahead of an approaching squall line in southeast Nebraska, and the other was taken within the cold pool immediately behind the line. Use these two soundings to answer the following questions:

- a. Retrieve the two raw sounding files from the website. You'll need to clean these up a bit prior to usage (e.g., removing missing values).
- b. Using the two soundings, produce a plot showing the variation in B , the buoyancy, with height (plot with $-p$ as the vertical coordinate) To do so, use an appropriate expression for B (you may neglect the impacts of all hydrometeors, since this information is not available in the sounding).
- c. Using this plot, estimate H , the depth of the cold pool. How did you arrive at this estimate?
- d. Using your profile of B and estimate of H , compute the theoretical speed of the cold pool, C , using the general cool pool speed equation we derived in class (M&R equation 5.45).
- e. Compare the theoretical cold pool speed computed in (d) with three additional estimates:
 - i. the theoretical speed C using equation 5.46 in M&R (which assumes a linear profile for B).
 - ii. the theoretical speed C assuming an anelastic atmosphere (instead of a Boussinesq atmosphere as was assumed in the derivation of 5.45), provided below,

$$C^2 = -\frac{2}{\bar{\rho}(z=0)} \int_0^H (\bar{\rho}B) dz$$

- iii. an estimated speed based on radar imagery available in the NCAR MMM image archive (archive link provided on the course webpage).
- f. Compare the estimated observed speed (based on radar imagery) with the four speeds computed above. Which theoretical speed is closest to the observed speed? *Hint*: you'll first need to adjust the speeds so they are *ground-relative* with an estimate of the surface wind speed ahead of the line. Make sure to justify your estimate.
- g. What factors might contribute to differences between the various theoretical speeds and the observed cold pool speeds for this case? Provide a paragraph or two discussing these issues.