

ATMO 489/689: Radar Meteorology

Laboratory #4, 09/25/06

Radar Wave Propagation

Due: By the beginning of next lab session

Questions (55 points):

1. (30 points) *Refractivity in the real atmosphere:* You will want to use a spreadsheet program for this question. Using all mandatory- and significant-level rawinsonde data from today's (09/25/06) Fort Worth, Texas (KFWD) early morning (12Z) atmospheric sounding¹,

- a. (5 points) Graph temperature and dewpoint temperature with respect to height (h, km).
- b. (15 points) Calculate and graph the height dependence of the refractivity, N, both with and without the effects of water vapor. Compare and discuss.
- c. (5 points) Calculate and graph the height dependence of the vertical gradient of refractivity (dN/dh). Consider water vapor effects.
- e. (5 points) In the lowest 1 km of the atmosphere, compare your calculated dN/dh to that for a standard atmosphere. Discuss the type of refraction you would expect as a function height.

2. (25 points) *Refractivity, 4/3rd Earth radius, and beam height:*

In the late evening, you are scanning a storm at 60 km range with 10 cm radar. The beam axis is pointed at 0.5° elevation angle. Rawinsonde data show a strong surface-based inversion layer in which both the dry-bulb and dew point temperatures vary nearly linearly between the two data levels shown in Table 1.

Table 1.

| | P (mb) | h (m) MSL | T (°C) | T _d (°C) | e or P _w (mb) | N |
|---------|--------|-----------|--------|---------------------|--------------------------|---|
| Surface | 970 | 450 | 26 | 20 | | |
| | 900 | 1000 | 28 | 25 | | |

- a. (5 points) Calculate e, the vapor pressure of moist air and then the refractivity, N, for each level.
- b. (7 points) Determine the actual height of the beam axis above the earth at the storm.
- c. (6 points) Compare the height calculated in (b) to the height calculated by assuming a 4/3-earth radius model. Briefly discuss your result.
- d. (7 points) Compare the height calculated in (b) and (c) to the height calculated by making no correction for refractive index effects. Again, briefly discuss.

¹ The following University of Wyoming Internet site has an easy to use interface for obtaining a text list of atmospheric sounding data that you need for this lab: <http://weather.uwyo.edu/upperair/sounding.html>