

PHYSICS 535, Fall 2010 – ASSIGNMENT 3

Reading

Summary of Rakov Ch. 3 (through end of Ch. 3) and 2 questions about the reading. Also read Vonnegut and Moore 1977 (“The Thundercloud”). Two questions about this too. As ever, have at least tentative answers to half the questions. Reading summary and questions for Ch. 3 and Vonnegut and Moore due 9/16.

PROBLEM SET #3 – Due 9/21 :

3-1) Calculate potential on axis for a disk of charge. Differentiate to get E.

3-2) A balloon sonde measures Electric field vs. altitude and deduces charge vs. altitude. If you knew charge vs. altitude, you could get E-field. You did this problem last week for infinite slabs of charge. Repeat it with disks of charge. The disks all have radii of 1 km. Calculate and plot E(z) vs. z. On the same plot include E(z) vs. z from problem 2.5.

$$\rho = 0.0 \text{ nC/m}^3 \quad 0 < z < 3 \text{ km}$$

$$\rho = 0.7 \text{ nC/m}^3 \quad 3 < z < 3.7 \text{ km}$$

$$\rho = 0.0 \text{ nC/m}^3 \quad 3.7 < z < 5 \text{ km}$$

$$\rho = -5.4 \text{ nC/m}^3 \quad 5 < z < 5.15 \text{ km}$$

$$\rho = 0.0 \text{ nC/m}^3 \quad 5.15 < z < 6 \text{ km}$$

$$\rho = 1.6 \text{ nC/m}^3 \quad 6 < z < 6.55 \text{ km}$$

$$\rho = -1.0 \text{ nC/m}^3 \quad 6.55 < z < 6.90 \text{ km}$$

3-3) Calculate the upper and lower screening layer charge density for reasonable assumptions about conductivity in clouds and free air and reasonable assumptions about charge density in clouds.

3-4) Plot field-mill data for the storm that occurred on Wednesday September 8, 2010. Make a summary plot that includes data from the kiva, the balloon-hangar and the annex. Comment on features of your plots. (I will place the data in /usr/local/nfs/fieldmill on babelfish).

3-5) Use xlma, matlab, a calculator, and your wits to numerically calculate the leader propagation speeds of flashes bb and cc on 20091020. Can you see any trends? Is the leader at the very beginning of the flash traveling at the same speed as in the latter part of the flash? Does the part of the leader going to ground move at a different speed than when it is propagating at constant altitude in the clouds?