

EVST201/G&G 140a **The Atmosphere, Ocean and Environmental Change**

Problem Set #3 (Due Friday, Sept.23)

1. If the mixing ratio of carbon dioxide is 380ppmv, determine the total mass of CO₂ in the earth's atmosphere. Hint: Don't forget the difference in molecular weights (29 for air, 44 for CO₂). The mixing ratio in ppmv is a ratio of the number of molecules.
2. What is the pressure at the bottom of a 30 meter deep lake?
3. If the air temperature at the earth surface is 20C and the air temperature at the tropopause (at 12km) is -60C, determine the average lapse rate in the troposphere. Is this lapse rate stable to dry lifting? Is it stable to moist lifting(i.e. in clouds)? Why?
4. Consider an air parcel at an altitude of 5km with T = -20C. If this parcel is brought down to sea level adiabatically, what will its new temperature be? Why did its temperature change?
5. Define the term "inversion". Explain why an inversion is resistant to vertical mixing. How do inversions form?
6. Imagine that a metric ton of gaseous pollutant is released into a small closed valley, with length 10km and width 2km. An inversion at 700 meters above the valley floor prevents mixing with the free atmosphere. Estimate the pollutant concentration (by mass) in the valley.
7. A steady bonfire in a steady westerly wind (10m/s) causes a smoky plume to the east. The source creates a billion small smoke particles each second. The turbulence in the atmosphere gives a diffusivity of $K=100\text{m}^2/\text{s}$. Consider two homes: A and B. Home A is 10km directly east of the source. Home B is 1km north of A. Is home B in the plume? Find the smoke concentration at each home. Express your answers in the number of particles per cubic meter.
8. If the dewpoint is 5C, and temperature is 15C, estimate the relative humidity. [Use tables in Ahrens]
9. What is the difference, if any, between the concepts of dew point temperature and wet-bulb temperature?
10. Estimate the time required for pollution to be carried around the world at a latitude of 45N by a jet stream wind with speed 100m/s. Express your answer in days.