CE 37200: Environmental Impact Assessment
Homework 6
Chapter 7
Due: Apr. 17

1) On a spring afternoon, a temperature of 70˚F is measured at the surface, while the air temperature at an altitude of 2 km is 50˚F. What is the lapse rate for this layer of the atmosphere? What stability category does this lapse rate correspond to? What shape would you expect a pollutant plume to take under these conditions?

2) Obtain a current North America surface pressure map from
http://www.hpc.ncep.noaa.gov/sfc/namfntsfcwbg.gif
What is the direction of the pressure gradient force at New York City? What would be the geostrophic wind direction?

For the conditions shown, would you expect the geostrophic wind to be stronger at New York City than in most other parts of the country? How can you tell?

Include the map time and date (e.g. 1800Z 10 April, 2013) in your answer.

3)
Go to http://www.dec.ny.gov/airmon/index.php and obtain current air pollutant concentrations from CCNY or another station in the region. Compare the pollutant concentrations over the last 24 hours with NAAQS. Include the station name and the time and date in your answer.

Choose one of the measured pollutants. Write a paragraph (with sources properly cited) on the following: What are this pollutant's main sources and sinks? What measures might a construction project like expanding CCNY include to reduce the concentration of this pollutant?

4) Suppose there is a large NO_2 source located at (x, y) = (0m, 0m) in Manhattan, where x is parallel to the wind direction and y is perpendicular to it. It has the potential to affect air quality at a receptor located at (500m, 100m).

The height of the source is h = 20m, the plume rise Δh is 5m, the emission flow rate = 1,000 m^3/s and the NO_2 concentration in the emission is 5000 $\mu g/m^3$. The wind speed at 10m is 5 m/s and the temperature lapse rate is -0.014 ˚C/m.

Determine (a) the emission rate of NO_2 from the source (in g/s), (b) the atmospheric stability class (A-F), (c) wind speed (in m/s) at the plume centerline height H, (d) NO_2 concentration at the receptor using the Gaussian plume model and an upwind concentration of 1 $\mu g/m^3$. (e) Also, briefly list the assumptions of the Gaussian plume model.