ENGS-43 Winter 2008
ENVIRONMENTAL TRANSPORT & FATE

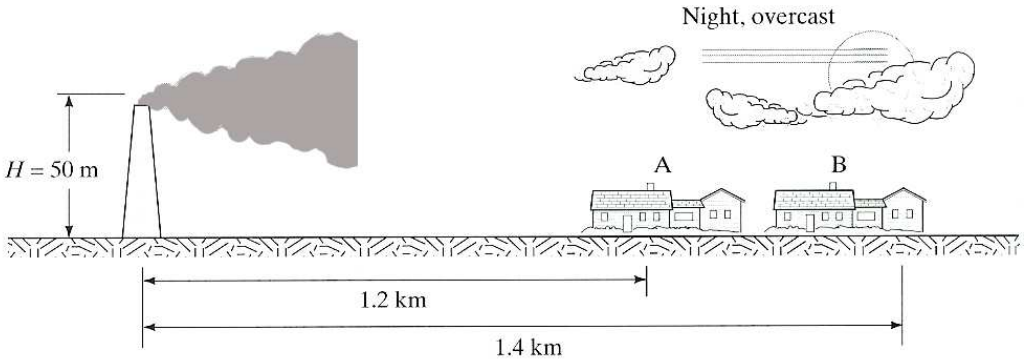
HOMEWORK #6

Assigned: Friday 29 February 2008
Due: 11:15a.m., Wednesday 4 March 2008
Note: This set is 3-page long. Make sure you download all 3 pages.

1. (5 points) Consider the set of plumes emitted from the tall stacks depicted in the picture below. How would you characterize them?

Note also the proximity to the sea and the little white plume much closer to the ground, toward the bottom left of the photo. Do you note anything peculiar about this plume? Doesn't this indicate to you why the three main stacks are so tall?

2. (10 points) (From Masters' book, Problem 7.33, page 447) A stack with effective height of 45 m emits SO_2 at the rate of 150 g/s. Winds are estimated at 5 m/s at the stack tip. It is morning time, and the lower atmosphere is slightly unstable, up to an inversion at 100 m. Estimate the ground-level concentration at the point where reflection begins to occur from the inversion and at the point twice that distance downwind.



3. (10 points) (Modified from Problem 7.20 in Masters' book on page 446) A power plant operates a stack with an effective height of 50 meters. The night is cloudy, and there is almost no wind. Your concern is with ground-level pollution at two locations, 1.2 km away (point A) and 1.4 km away (point B), both directly downwind from the stack.

a. (5 points) At which distance will the maximum concentration of pollution occur? Which location (A or B) would have the higher level of pollution?

b. (2 points) Suppose the sky clears up and the wind speed stays below 3 m/s. Will the location of the maximum concentration move? If so, will it move closer to the stack or further away from it? (The effective height remains at 50 m.)

c. (3 points) Under the new conditions of part b, which house would experience the most pollution?

4. (15 points) A hypothetical Chernobyl-type accident occurred at a nuclear power plant in San Francisco, California, on Friday the 13th of January 2006. Highly radioactive emissions lasted for two days (13 and 14 January) and rose sufficiently high in the atmosphere to be caught in the prevailing winds at 500 mb (millibars). Using the 500-mb weather charts for those days and a horizontal diffusivity of 1000 m^2/s, trace the path of each day's emission for that day and the next, documenting the direction taken, the distance covered, the widening of the cloud, and any possible precipitation along the way.

NOAA weather charts for the United States can be found at
http://www.hpc.ncep.noaa.gov/dailywxmap/index_20060113.html
The 500-mb charts are at the bottom left of each page. Click on this chart to make it bigger and reveal wind velocities. Helpful numbers are: 1 knot = 1 nautical mile per hour = 0.5144 m/s, 1 degree of latitude = 111 km. Also, note: Wind arrows on weather charts point in the upwind direction, one barb indicating 10 knots, half a barb 5 knots, and a solid triangle 50 knots.

Your report should consist of marked prints of the relevant weather charts accompanied by a narrative telling the progression of the radioactivity during each day and mentioning (qualitatively) any land deposition caused by rainfall.