

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Civil and Environmental Engineering
1.77 Water Quality Control

Problem Set 3

Spring 2006

Due March 9

A chimney emits SO_2 continuously at height H above a flat terrain. Assume that the wind is horizontal (x -direction) and uniform in the vertical (z -direction). Also assume that the plume is non-buoyant and that SO_2 behaves as a conservative pollutant.

- a) Develop a steady state solution for the maximum concentration distribution at ground level downwind of the chimney as a function of the mass rate of efflux, the wind speed, the chimney height, and the variances of the turbulent concentration field.
- b) For a 50 m high chimney in a 10 m/s wind, plot the ratio of maximum ground level concentration to source strength as a function of x ($0.1 \text{ km} < x < 10 \text{ km}$) assuming sunny daytime conditions.
- c) Give the governing differential mass transport equation for this problem in terms of diffusivities, stating any assumptions you have made. How would you solve a similar problem if it were desired to account for the fact that the wind speed is non-uniform in the vertical direction? Only a discussion is required.