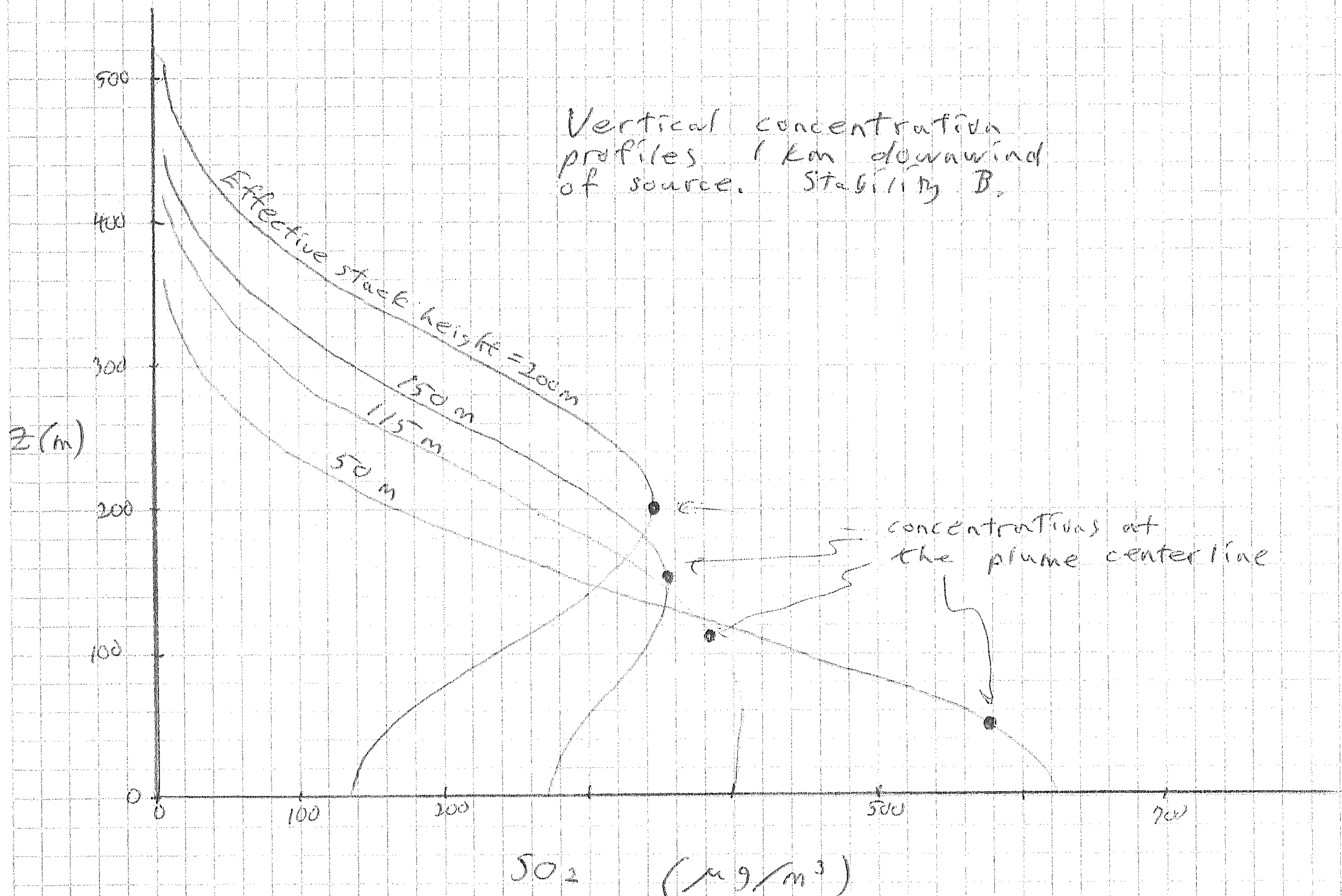
Scan Set A

ATSC 595D
Stull

Example of Reflection from ground

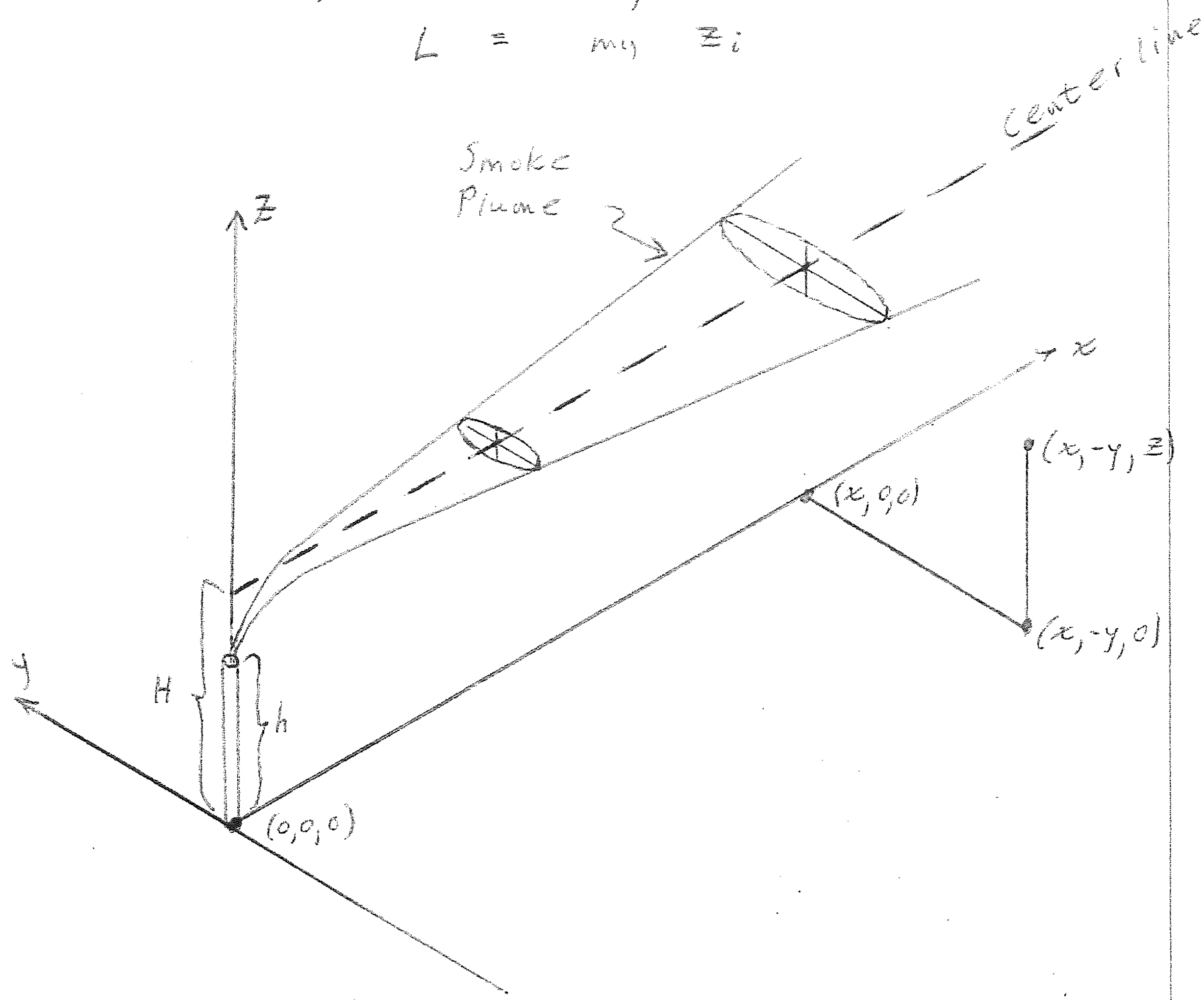
(Gaussian Plume)



4. Practical Applications of Gaussian Diffusion

a. General Form

(Note: Turner's $\chi \equiv$ my c.
$L =$ my z_i



$$\boxed{c(x,y,z,H) = \frac{Q}{2\pi\sigma_y\sigma_z\bar{u}} \cdot e^{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2} \cdot \left[e^{-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2} + e^{-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2}\right]} \quad \text{IV.B.4.1}$$

Get σ_y & σ_z from tables, graphs, or formulas

$\sigma = \sigma(x, TKE, z_0)$

See Pasquill & Gifford's empirical curves: Turners Fig 3-2, 3-3 p3

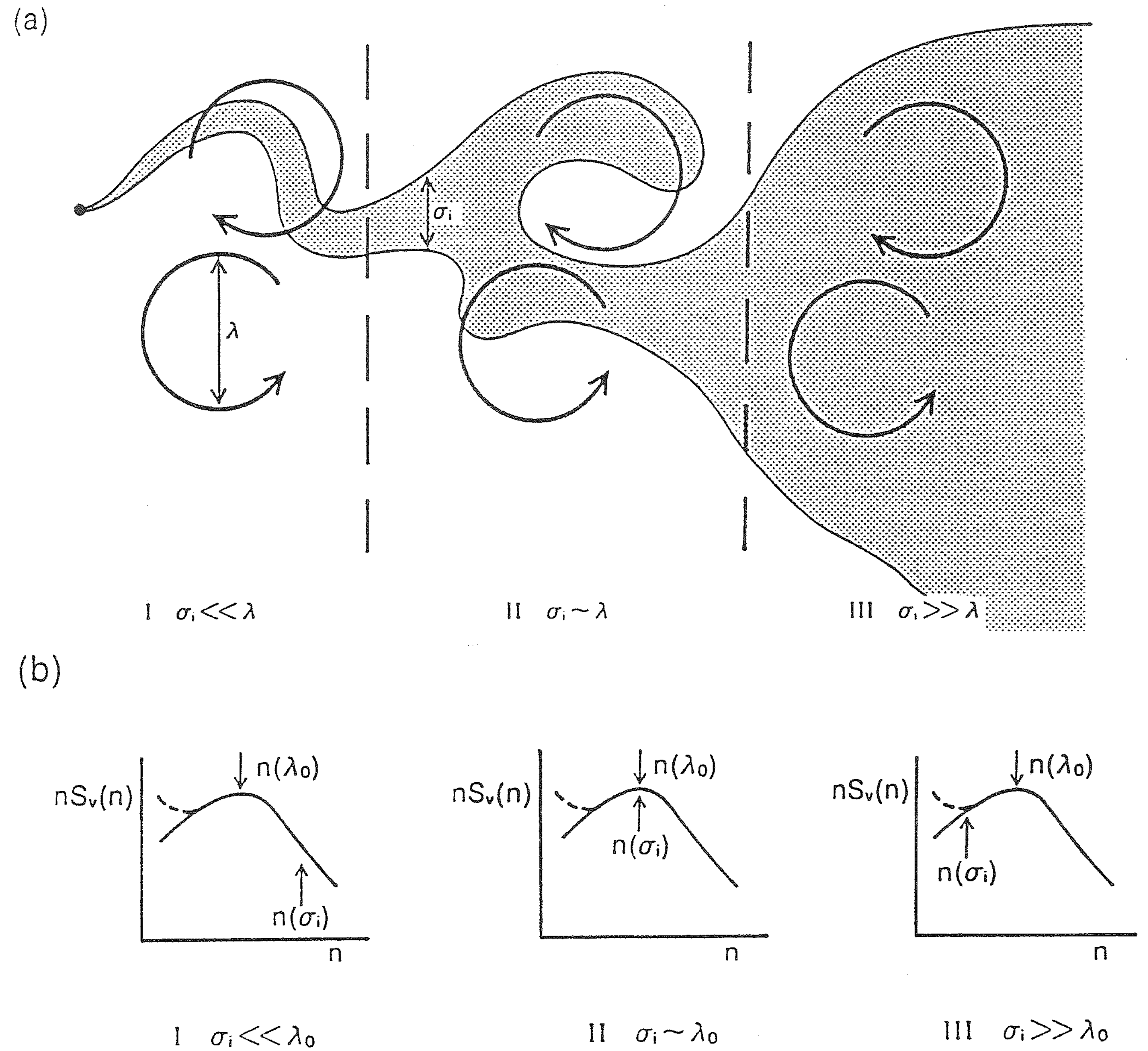
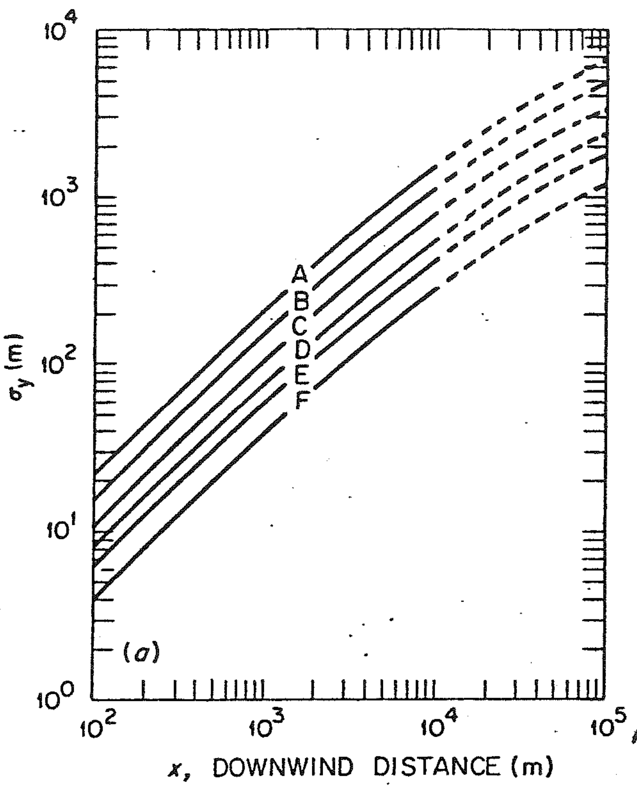


Fig. 9. An illustration of the conceptual model of plume dispersion. Part (a) shows the three different effects of eddies of length scale λ according to the relative size of the crosswind length scale of the instantaneous plume σ_i. Part (b) illustrates how the plume development depends on the form of the velocity spectra, using the example of the horizontal crosswind velocity v. Three regimes are defined similar to those defined in part (a) for the particular length scale λ_0 corresponding to the peak of the velocity spectrum $S_v(n)$, and the growth and structure of the plume as a whole depends on the relative scales of σ_i and λ_0 as described in the text. The dashed lines show a possible form of the increased energy at low-frequency in stable conditions due to large-scale two-dimensional meandering motions.

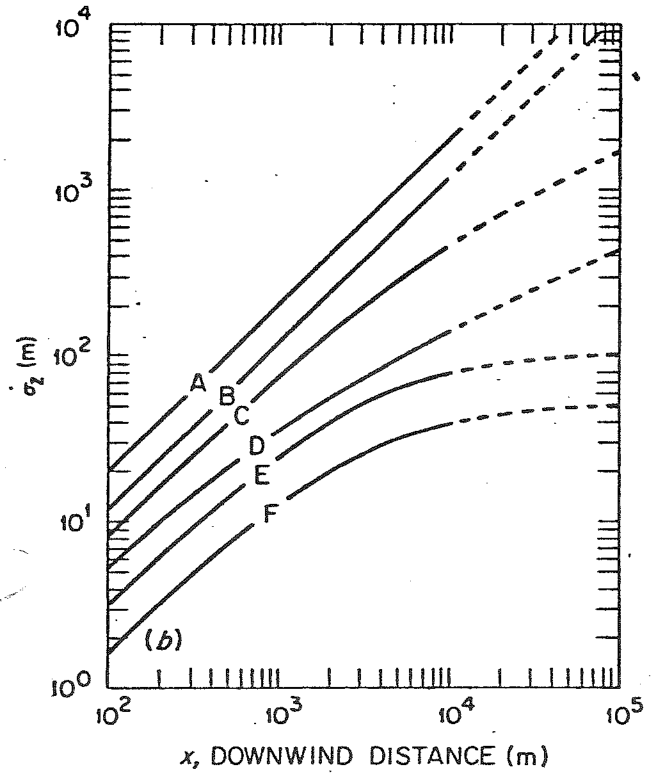
eddies with increasingly large λ, so that this model was able to explain the observation in M&M91 that the inertial subrange extends to lower frequencies at longer range. In stable conditions the observations appear to show that the instantaneous plume is less fragmented at a range of around 100 m than it is in near-neutral stability. This suggests that the process shown in Figure 9aII is reduced and therefore that eddies with $\lambda \sim \sigma_i$ are relatively weak. In order to extend the

Formulas recommended by Briggs (1973) for $\sigma_y(x)$, m, and $\sigma_z(x)$, m; $10^2 < x < 10^4$ m, open country conditions.

Pasquill Type	$\sigma_y(m) =$	$\sigma_z(m) =$
A	$.22x(1+.0001x)^{-1/2}$	$.20x$
B	$.16x(1+.0001x)^{-1/2}$	$.12x$
C	$.11x(1+.0001x)^{-1/2}$	$.08x(1+.0002x)^{-1/2}$
D	$.08x(1+.0001x)^{-1/2}$	$.06x(1+.0015x)^{-1/2}$
E	$.06x(1+.0001x)^{-1/2}$	$.03x(1+.0003x)^{-1}$
F	$.04x(1+.0001x)^{-1/2}$	$.016x(1+.0003x)^{-1}$



(a)



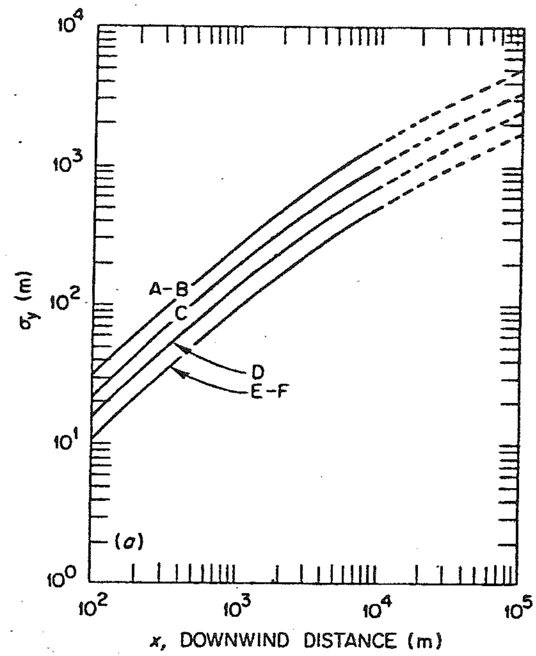
OLD

σ_y & σ_z Formulae

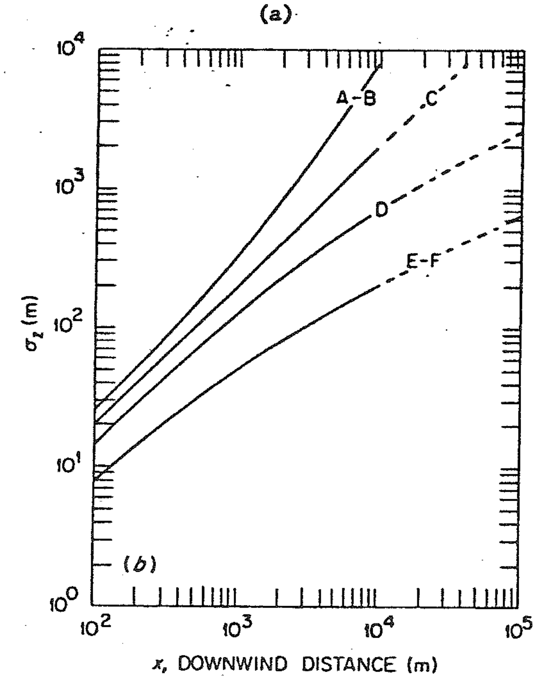
p4

Formulas recommended by Briggs (1973) for $\sigma_y(x)$, m and $\sigma_z(x)$, m; $10^2 \leqslant x \leqslant 10^4$ m, urban conditions.

Pasquill Type	$\sigma_y(m) =$	$\sigma_z(m) =$
A–B	$.32x(1+.0004x)^{-1/2}$	$.24x(1+.001x)^{1/2}$
C	$.22x(1+.0004x)^{-1/2}$	$.20x$
D	$.16x(1+.0004x)^{-1/2}$	$.14x(1+.0003x)^{-1/2}$
E–F	$.11x(1+.0004x)^{-1/2}$	$.08x(1+.0015x)^{-1/2}$



(a)



(b)

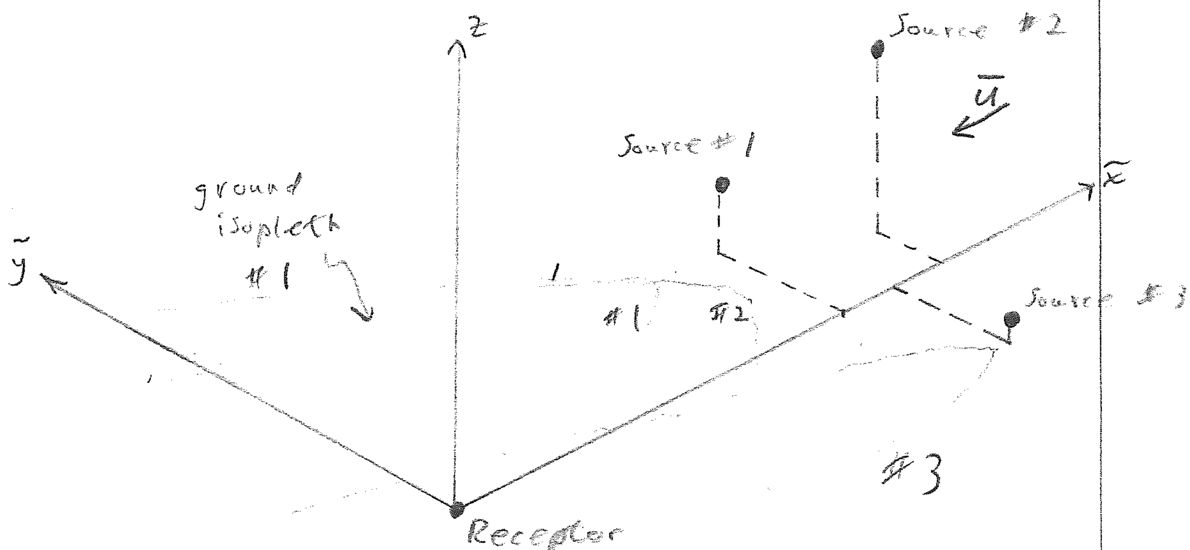
Figure 6. Curves (a) of σ_y and (b) of σ_z based on Briggs' (1973) interpolation formulas for flow over urban areas, see Table 2; from Hosker (1974).

Multiple sources

Superposition

IV.B.4.b

$$\boxed{C_{Receptor} = C_1 + C_2 + C_3 + \dots}$$



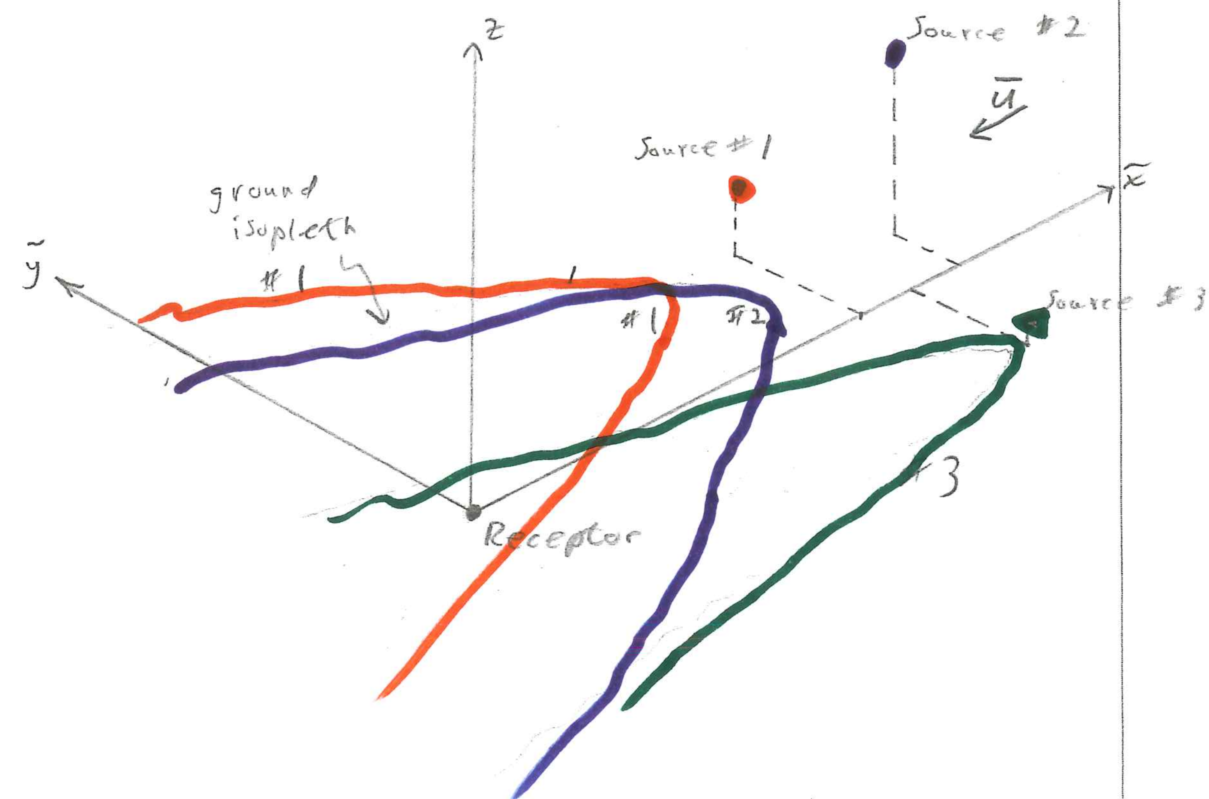
Note, if we are concerned about predicting the point on the ground where the maximum concen will occur, often the easiest way is to manually superimpose plots of ground isopleths, & sum.

Multiple sources

Superposition

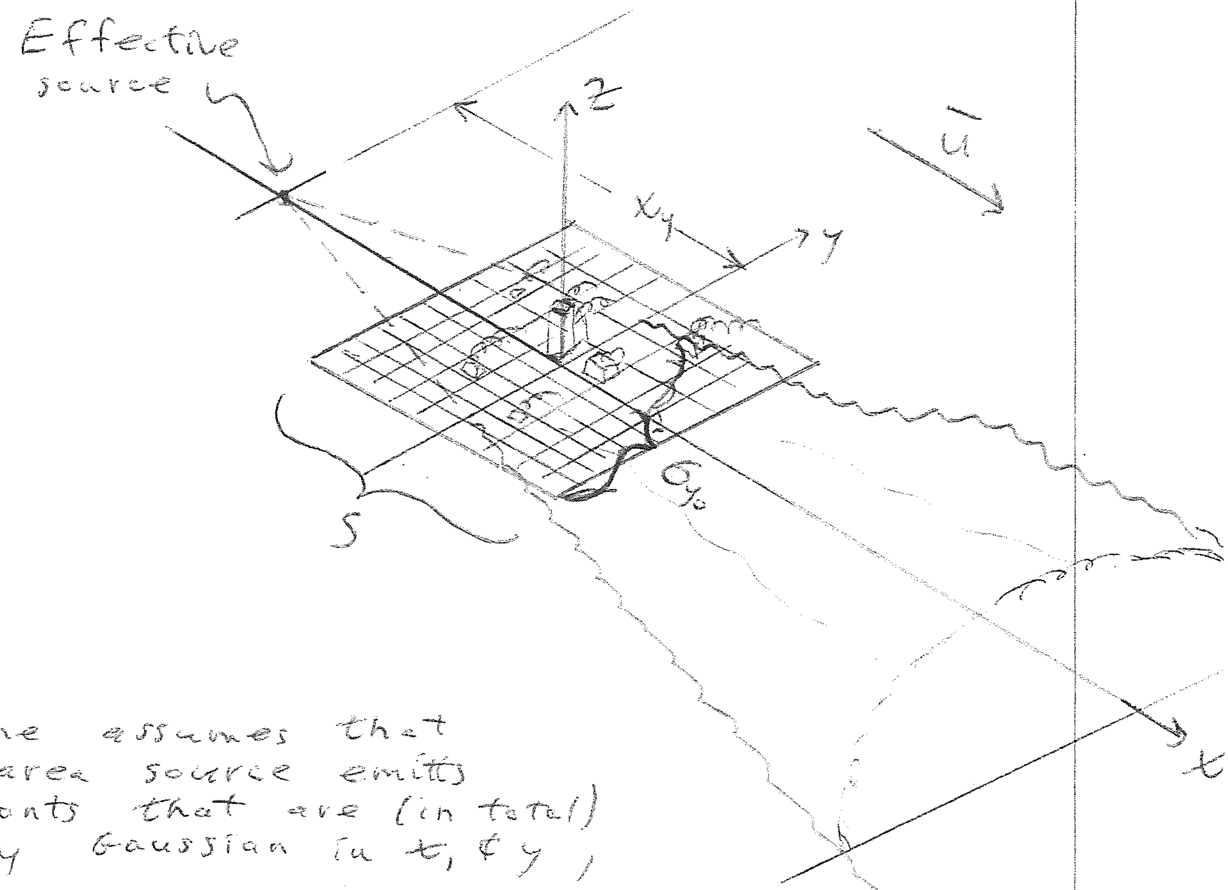
IV.0.4.16

$$\boxed{C_{Receptor} = C_1 + C_2 + C_3 + \ldots}$$



Note, if we are concerned about predicting the point on the ground where the maximum concen will occur, often the easiest way is to manually superimpose plots of ground isopleths, & sum.

c) Point Source approximation to Area Sources



If one assumes that the area source emitts pollutants that are (in total) roughly Gaussian in x, & y,

then, we can approximate this area by an upwind point source at ground level

ex/ step 1) Guess σ_{y_0} at the area source.

(For a square source, (s = side of square), $\sigma_{y_0} \approx \frac{s}{4.3}$)

2) Based on the actual stability, go to Fig. 3-2 to find the value of x_y which would have given the $\sigma_y = \sigma_{y_0}$ at the city.

3) Use this upwind effective source in the normal point source eqs. to solve for C downwind from point.

Use emission inventory.

Note, if not a ground source, then must solve for x_z, which may be different from x_y.