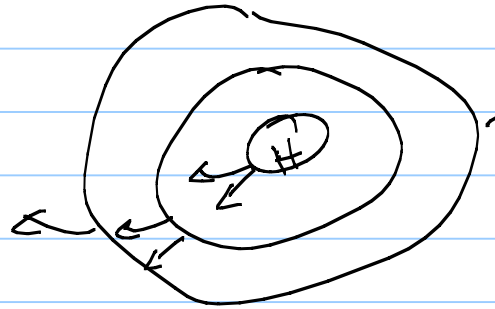
# AIR DISPERSION LAB

Note Title 1/30/2008

wind
emited compound
temperature - stability
background concentration / other sources
emission rate
topography
height of stack

# Atmospheric Engine (Stability)

- expanding & contracting gases
- resulting from pressure




wind flow from high pressure to low pressure

Turbulence - shear forces causes wind to be non-uniform

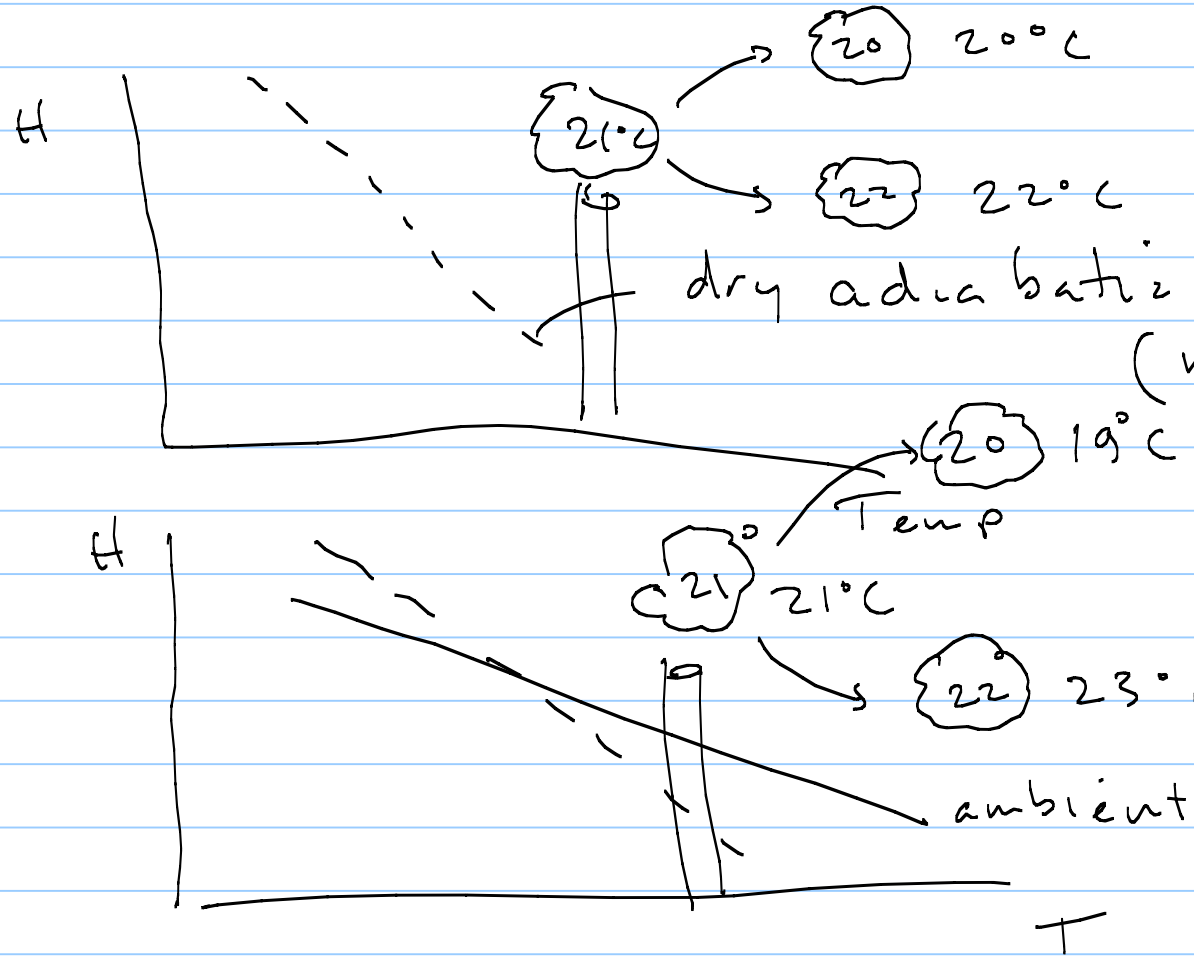
mechanical turbulence - eddies

thermal turbulence - heat from ground sources

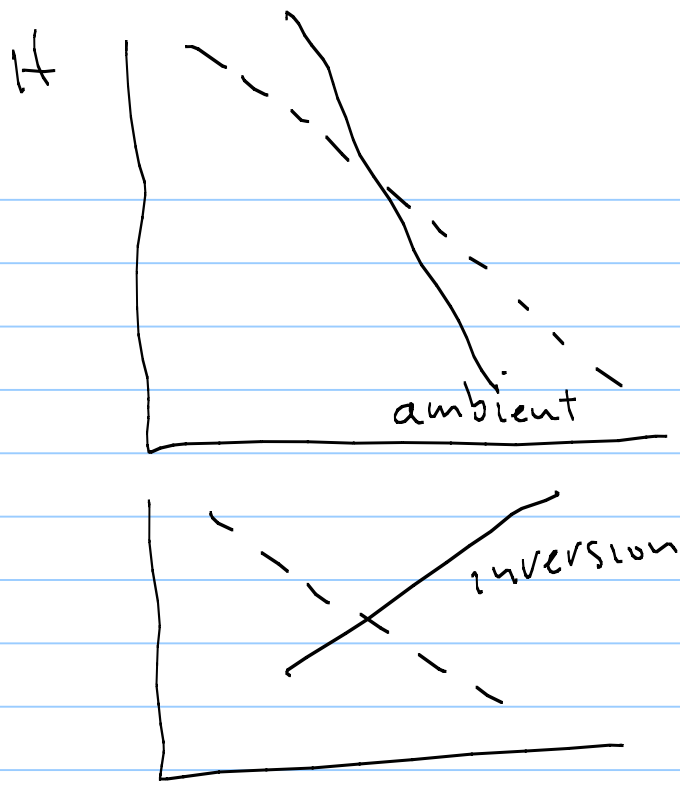
Stability - tendency of atmosphere to resist

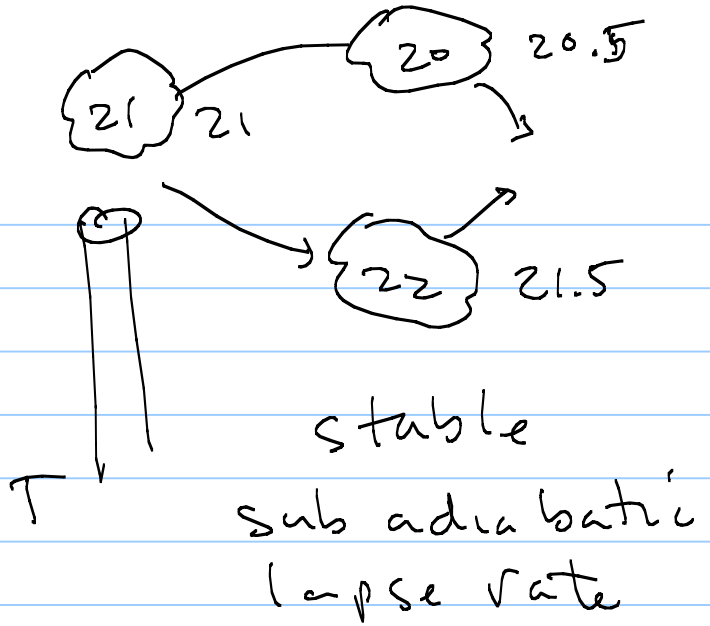
or enhance vertical motion

unstable – mech + thermal
neutral – mech
stable – thermal
turb inhibits mechanical




super adiabatic
lapse rate
(unstable)




stable

sub adiabatic

lapse rate

# Dispersion Model:

- Point source gaussian dispersion model
- developed by Turner
- good for rough estmates of ground level concentrations
- for instance where to place monitoring equip
- area to evacuate

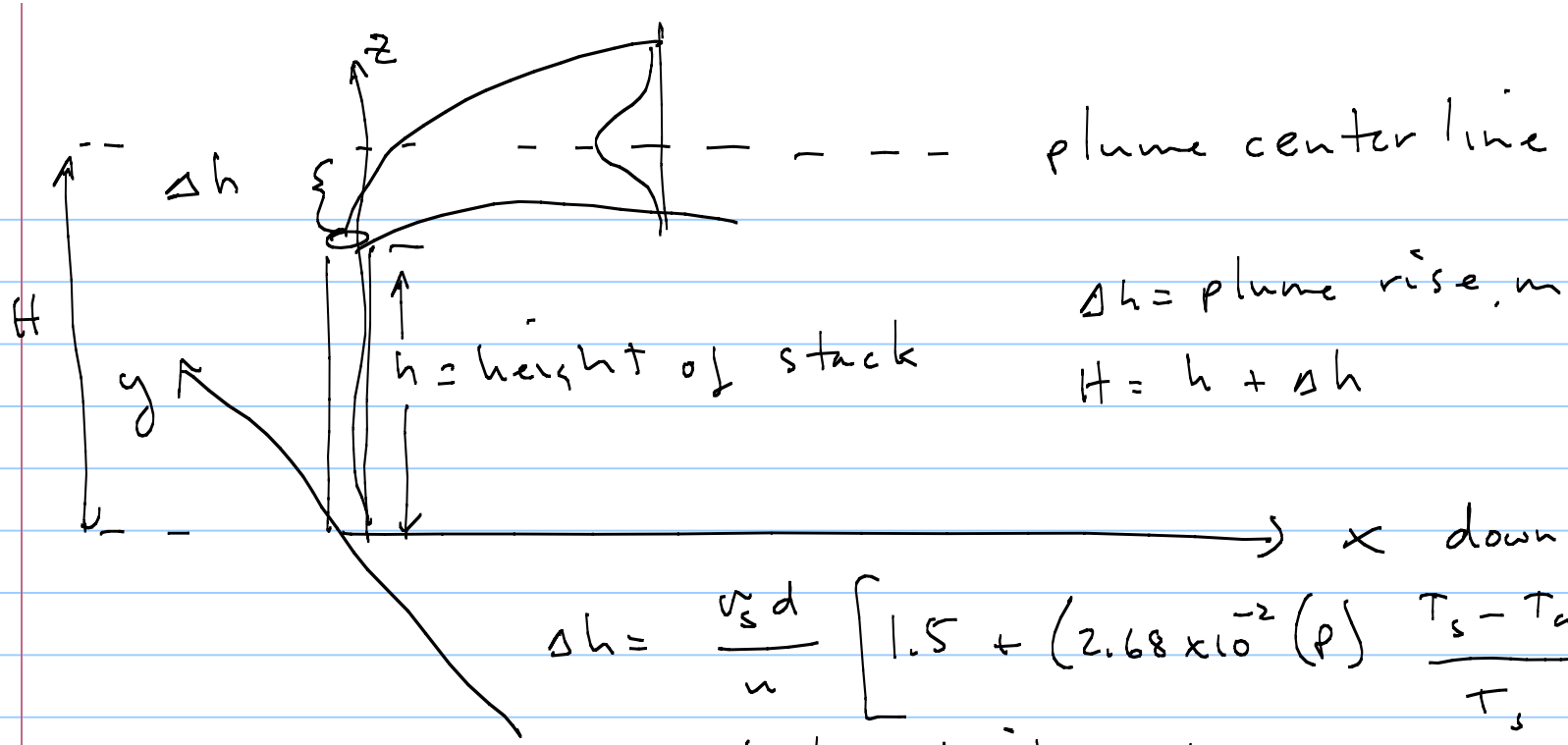
ground level downwind concentration g/m³ → $\chi = \frac{Q}{\pi \sigma_y \sigma_z u} \left[ e^{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2} \right] \left[ e^{-\frac{1}{2}\left(\frac{H}{\sigma_z}\right)^2} \right]$

where $Q$ = emission rate, g/s

$\sigma_y, \sigma_z$ = plume standard deviations, m

$u$ = wind speed, m/s

$x, y, z, H$ - distances in m




$\Delta h$ = plume rise, m

$H = h + \Delta h$

$$\Delta h = \frac{v_s d}{u}\left[1.5 + \left(2.68 \times 10^{-2}(P)\ \frac{T_s - T_a}{T_s}\right) d\right]$$

$v_s$ = stack velocity, m/s

$d$ = stack diameter, m

$u$ = wind speed, m/s

$P$ = pressure, kPa

$T_s$ = stack temp, K

$T_a$ = air temp, K

Martin's eq:

$$S_y = a x^{0.894}$$

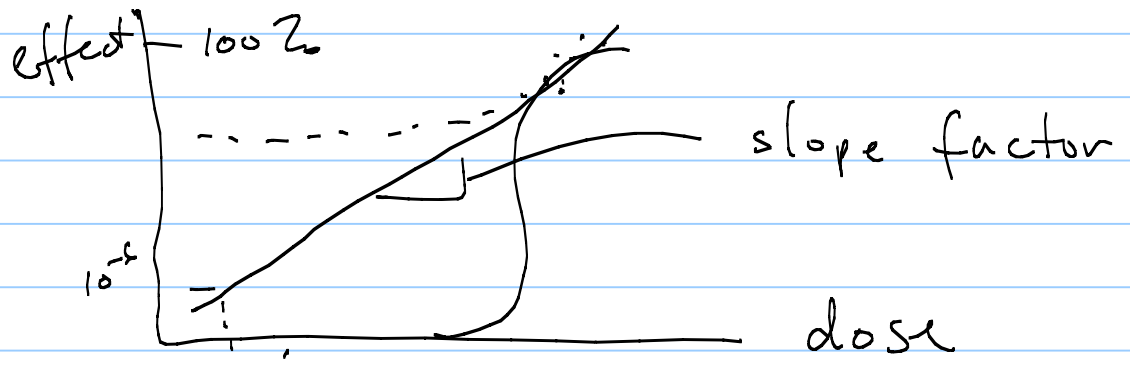
$$S_z = c x^{d} + f$$

a, c, d, f are given in Table 7-9 on page 545

enter X in km

output $S_y$ & $S_z$ in m

Risk Assessment – exposure dose $\longleftrightarrow$ risk (cancer)



General Risk Model: (inhalation)

$$TR = \frac{RBSL \cdot IR \cdot EF \cdot ED \cdot SF_i}{BW \cdot AT_c \cdot 365 \frac{d}{y} \cdot 10^3 \, mg/mg}$$

TR = target risk ($10^{-6}$ → one in a million risk)

RBSL = risk based screening level, $\mu g/m^3$
IR = inhalation rate, $m^3/d$
EF = exposure frequency, d/y
ED = exposure duration, y
BW = body weight, kg
$AT_c$ = averaging time for carcinogen, y
$SF_i$ = slope factor for inhalation $(mg/kg \cdot d)^{-1}$