Project Prairie Grass (O'Neill, Nebraska)

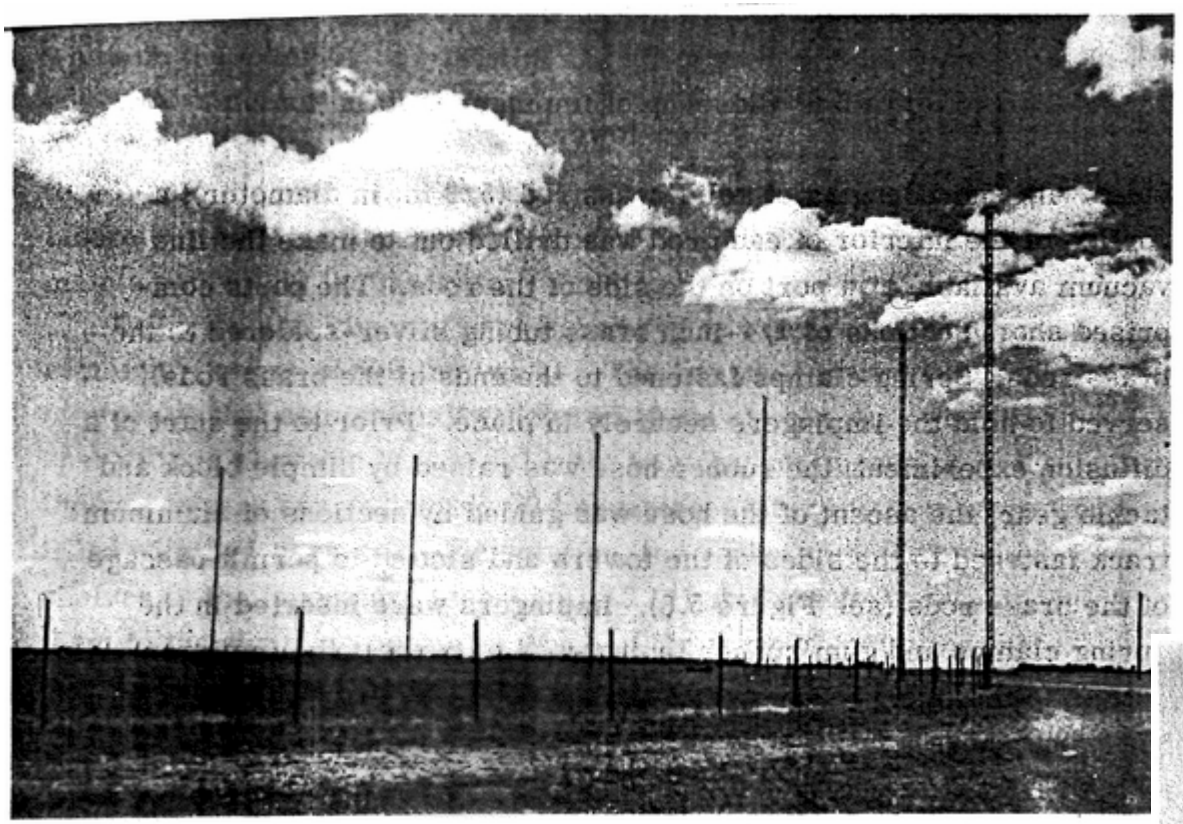


Figure 5.7 Tower array at 100-m arc.

- continuous source SO_2
- 10 min averaging times
- detectors from 50 m to 800 m
- more than 60 runs; wide range in Obukhov length *L*

$$U\frac{\partial \chi}{\partial x} = \frac{\partial}{\partial z}\left[K\frac{\partial \chi}{\partial z}\right]$$

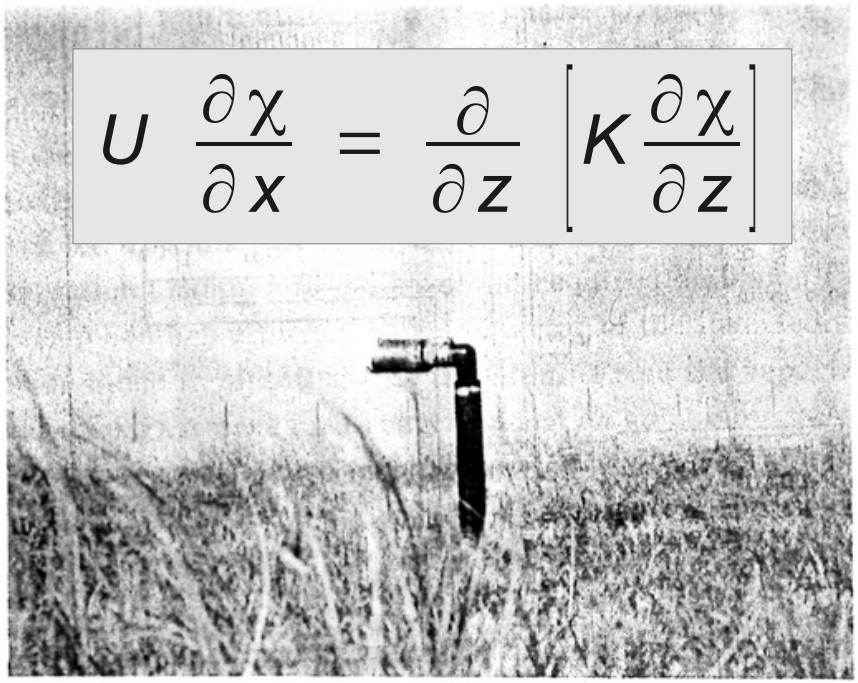


Figure 5.3 Release-point for the tracer.

- dry prairie grass, z_0 ~ 0.006 m
- surface thought non-absorbing
- arcs of detectors → compute XWIC $\chi=\chi(x,z)$

Haugen (1959, editor): "Project Prairie Grass, a Field Program in Diffusion (Vol.3)," Geophysical Research Papers No. 59, TR-58-235(III), Air Force Cambridge Research Center

Empirical prescription of plume widths: the Pasquill-Gifford curves

(Constant U, K solution)

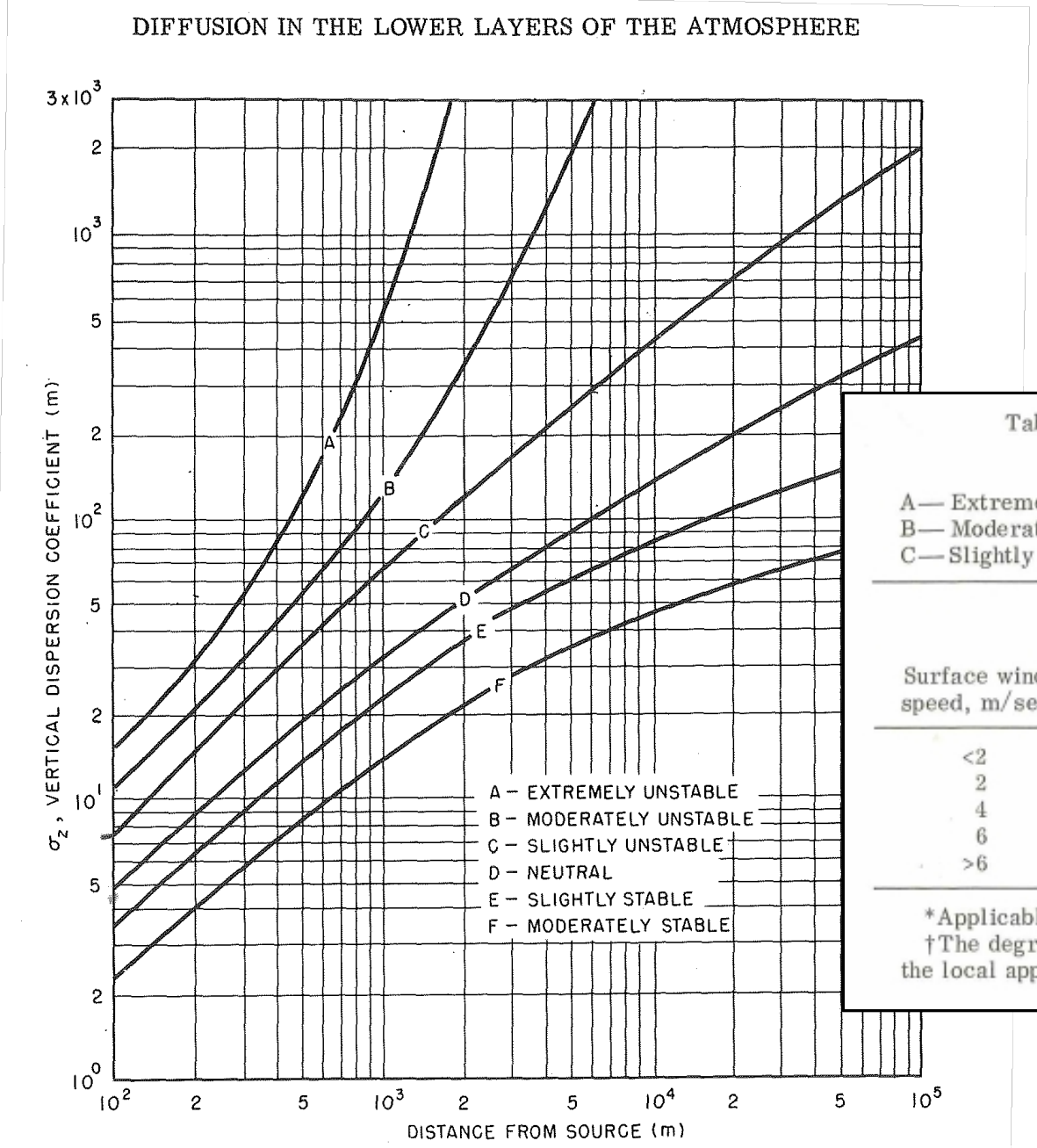


Fig. 3.11 — Vertical diffusion, σ_z, vs. downwind distance from source for Pasquill's turbulence types.

Table 3.3 — RELATION OF TURBULENCE TYPES TO WEATHER CONDITIONS

A — Extremely unstable conditions
B — Moderately unstable conditions
C — Slightly unstable conditions
D — Neutral conditions*
E — Slightly stable conditions
F — Moderately stable conditions

Surface wind speed, m/sec	Daytime insolation			Nighttime conditions	
	Strong	Moderate	Slight	Thin overcast or ≥ 4/8 cloudiness†	≤ 3/8 cloudiness
<2	A	A–B	B		
2	A–B	B	C	E	F
4	B	B–C	C	D	E
6	C	C–D	D	D	D
>6	C	D	D	D	D

*Applicable to heavy overcast, day or night.
†The degree of cloudiness is defined as that fraction of the sky above the local apparent horizon which is covered by clouds.

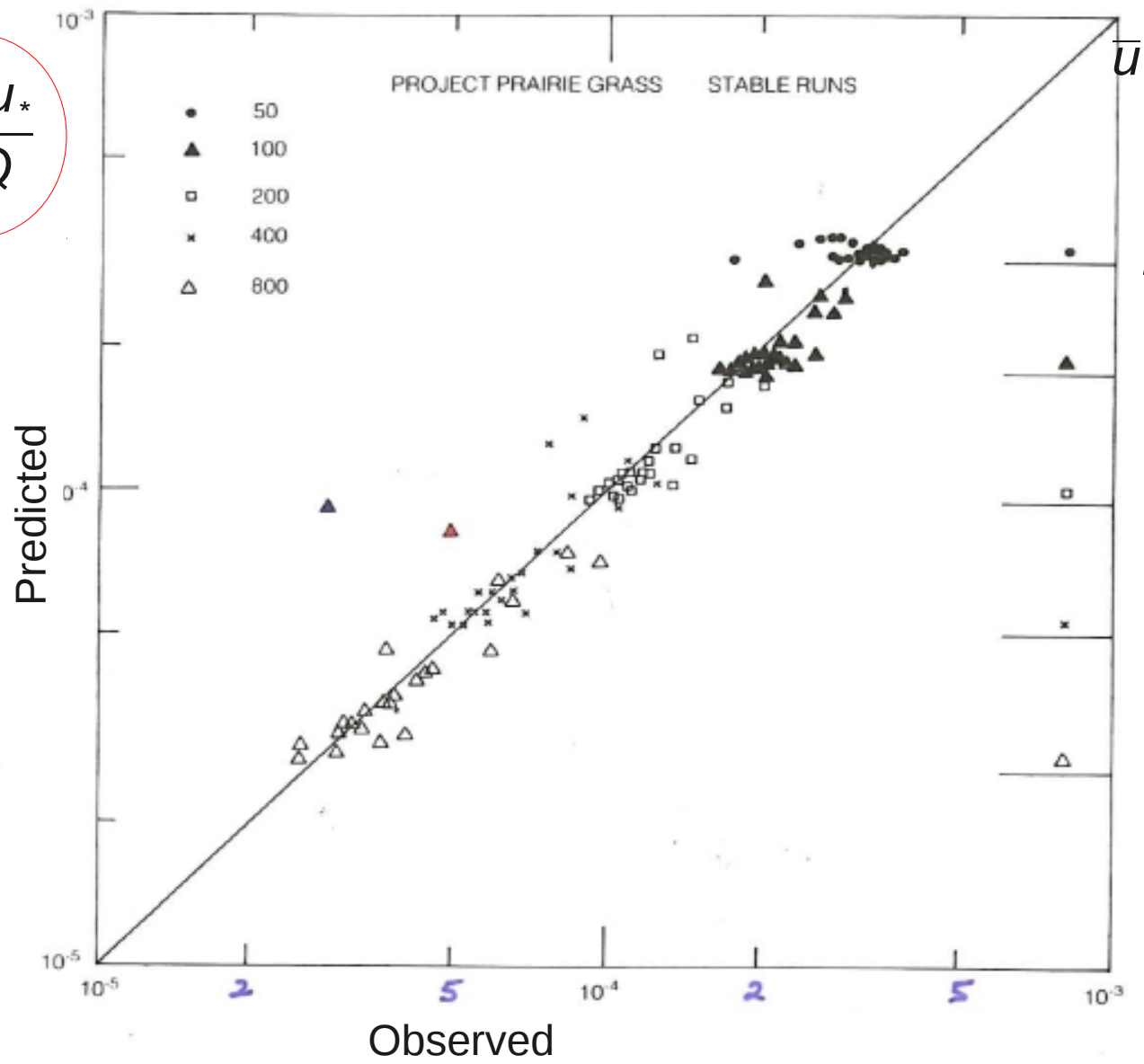
- what height to evaluate U ?
- role of z_0 ?
- dependence on averaging time?

Approx. analytic solution, MOST wind and diffusivity (Wilson 1982)

$$\frac{z_0 \chi u_*}{k_v Q}$$

$$\bar{u} = \frac{u_*}{k_v}\left[\ln\frac{z}{z_0} + 5\frac{z - z_0}{L}\right]$$

$$K = \frac{k_v u_* z}{1 + 5\frac{z}{L}}$$



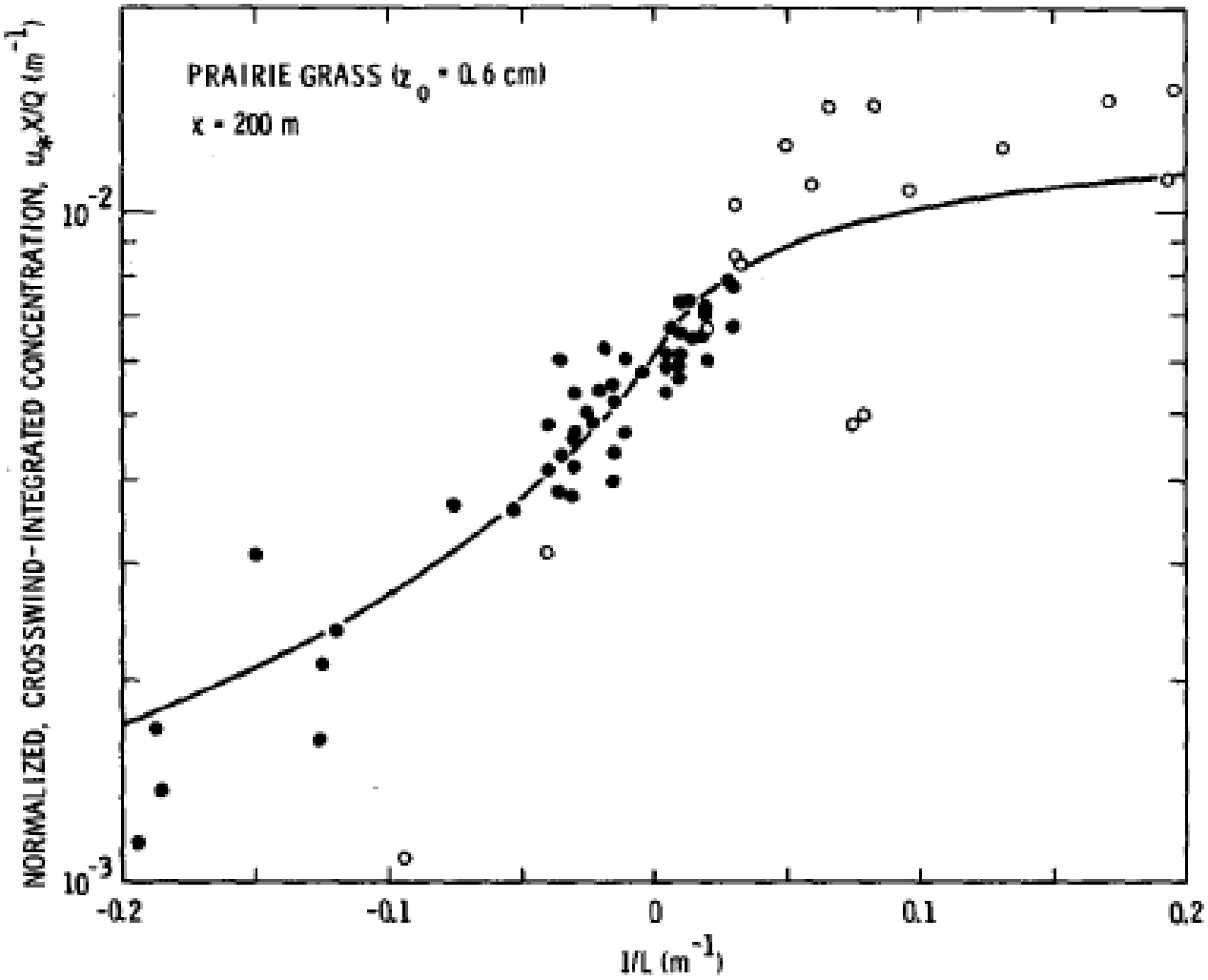
▲ run 35, L=3.5m

▲ run 53, L= 5.1 m

Fig. 9. Observed and predicted values of the dimensionless crosswind-integrated concentration at z = 150 cm and x = (50, 100, 200, 400, 800 m) for Project Prairie Grass runs occurring in stable stratifi-

Lagrangian similarity solution applied to Project Prairie Grass (Horst 1979)

$\frac{\chi u_*}{Q}$



$\frac{1}{L}$

FIG. 4. As in Fig. 2 except for 200 m downwind of the source.