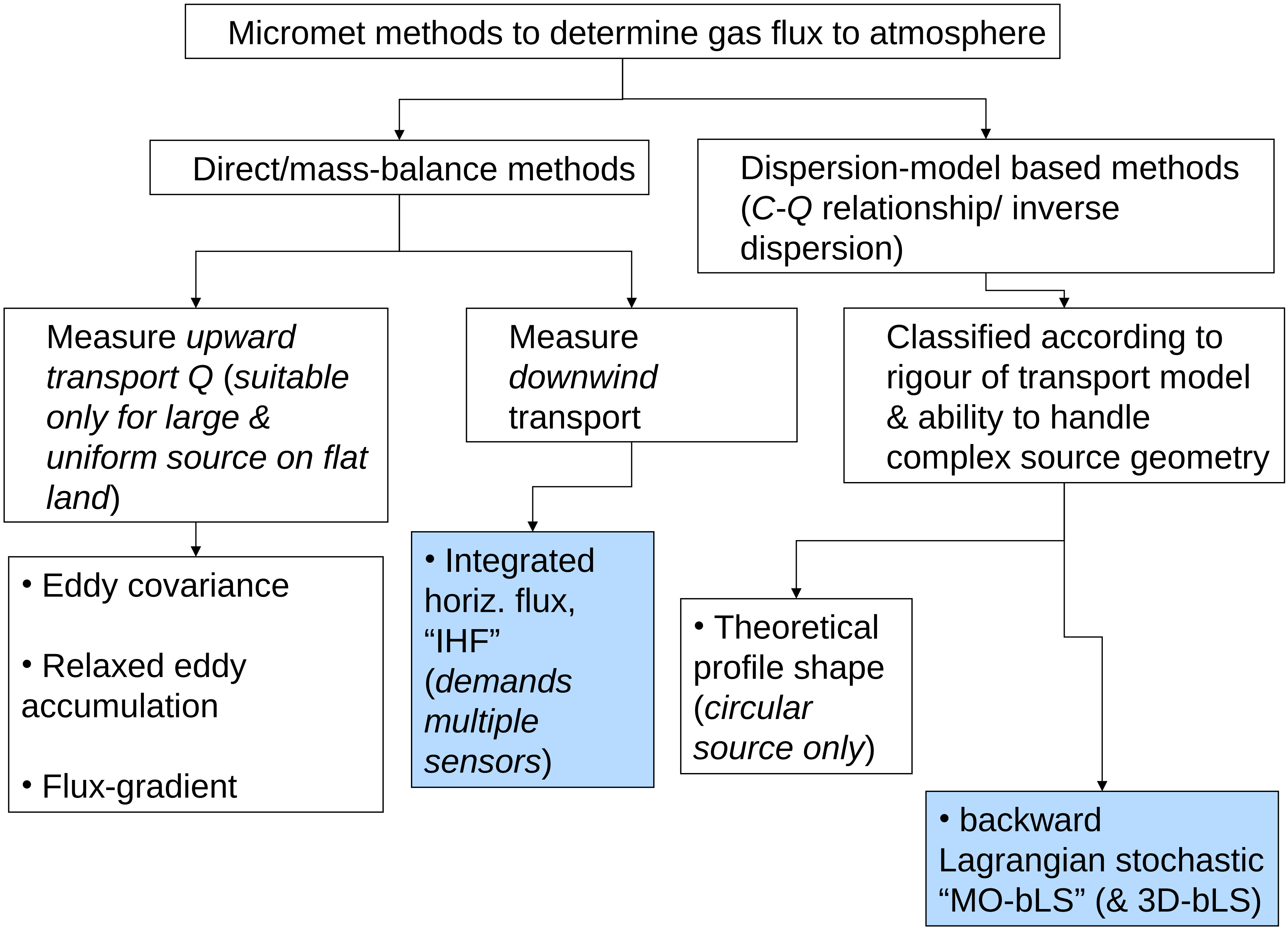
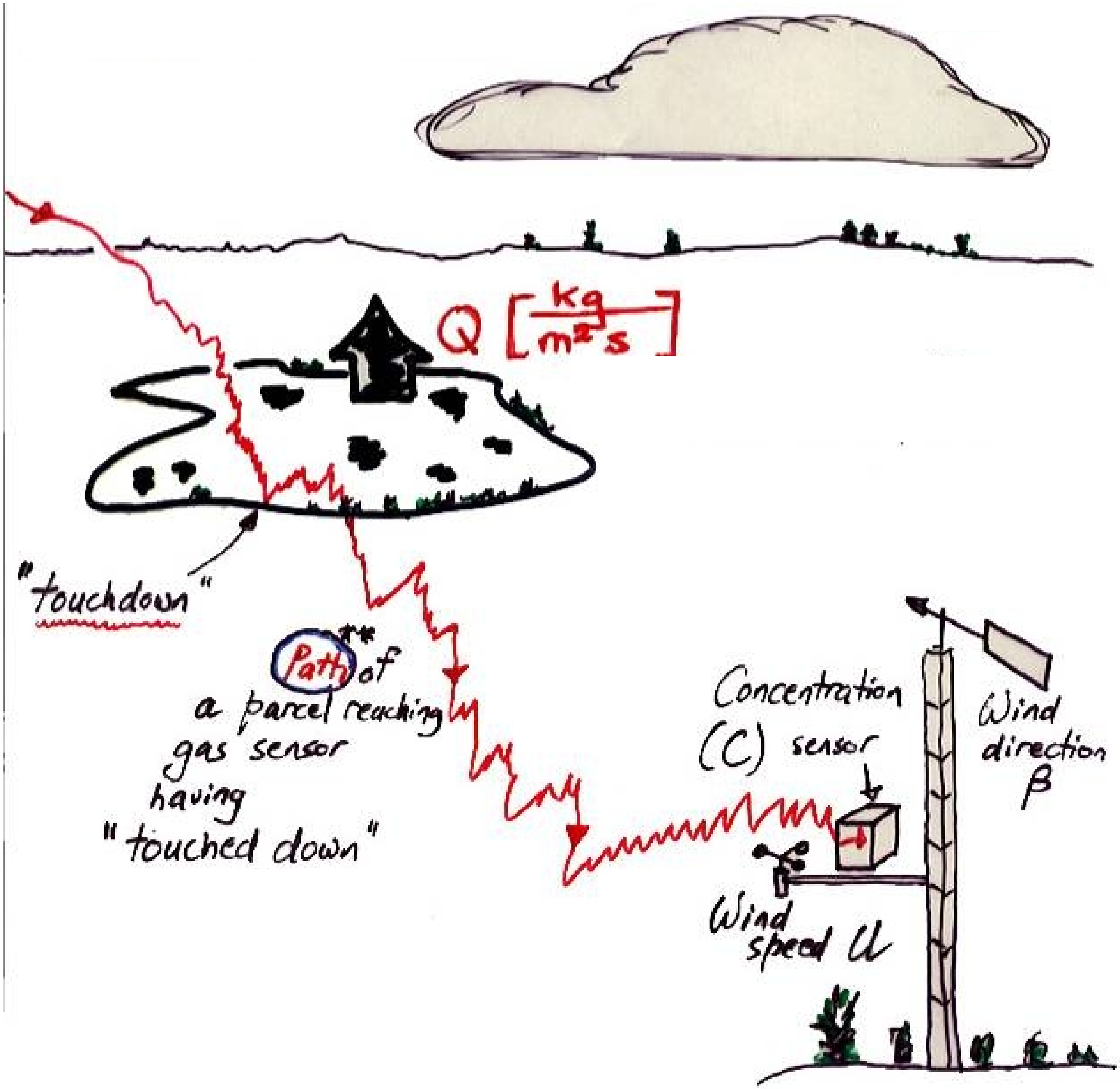


eas572_bLS.odp
JDW 29 Nov. 2012

“bLS” method to infer emission rate *Q* from measured concentration *C*



$$\frac{U\,(C - C_b)}{Q} = n$$

We may use a dispersion model to estimate the dimensionless number *n*, i.e. to determine the “*C-Q*” relationship…

Then, measuring *C* fixes *Q*

“bLS” method to infer emission rate *Q* from measured concentration *C*

- calculate trajectories *upwind* from point where *C* is measured
- efficient & simple to find *Q* from area source
- needed information lies in ensemble of touchdown locations and associated touchdown velocities w_0

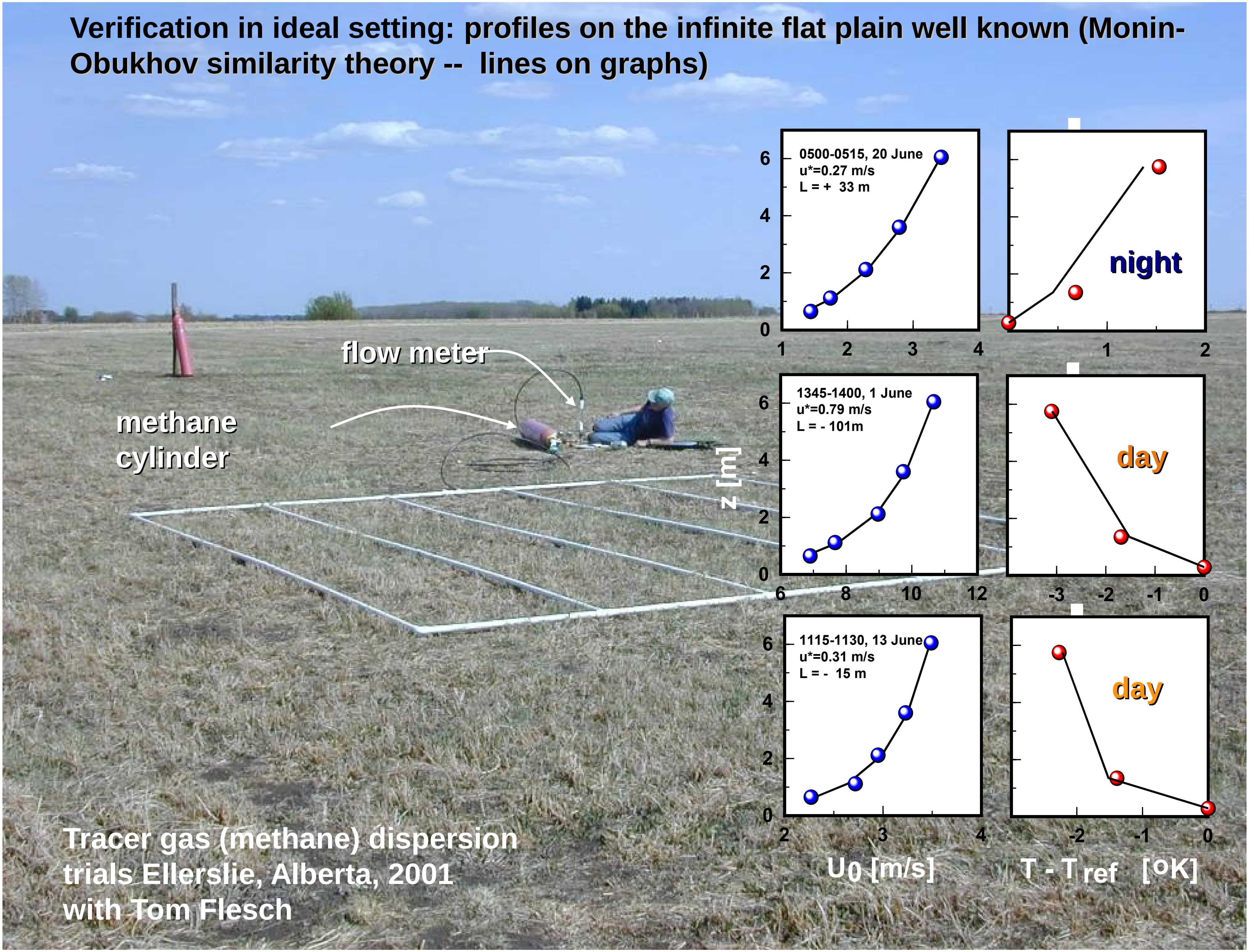
$$n = \frac{1}{N_P} \sum \frac{2\,U}{|\,w_0\,|}$$

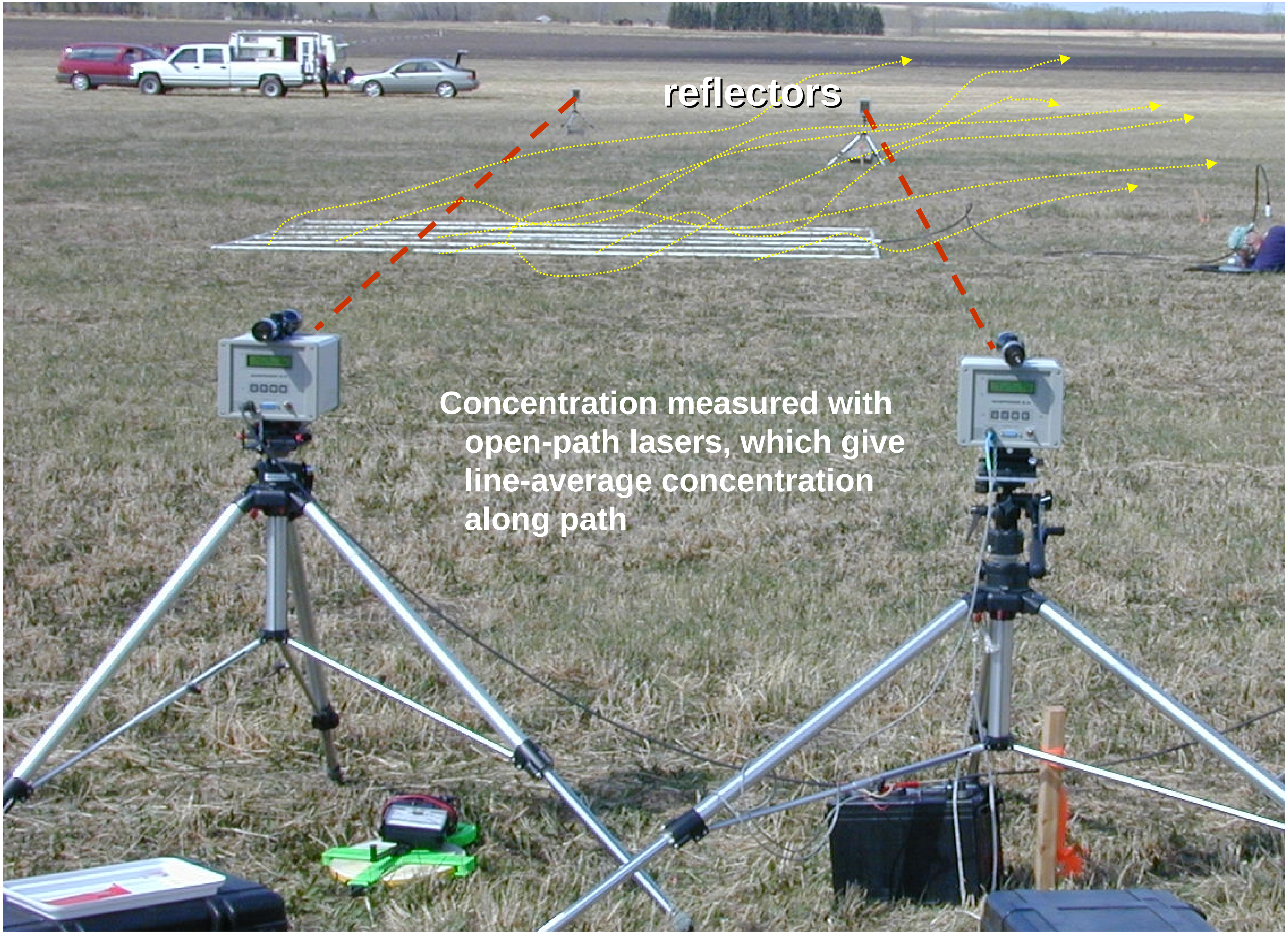
Compute N_P paths. Sum over all touchdowns within source boundary.

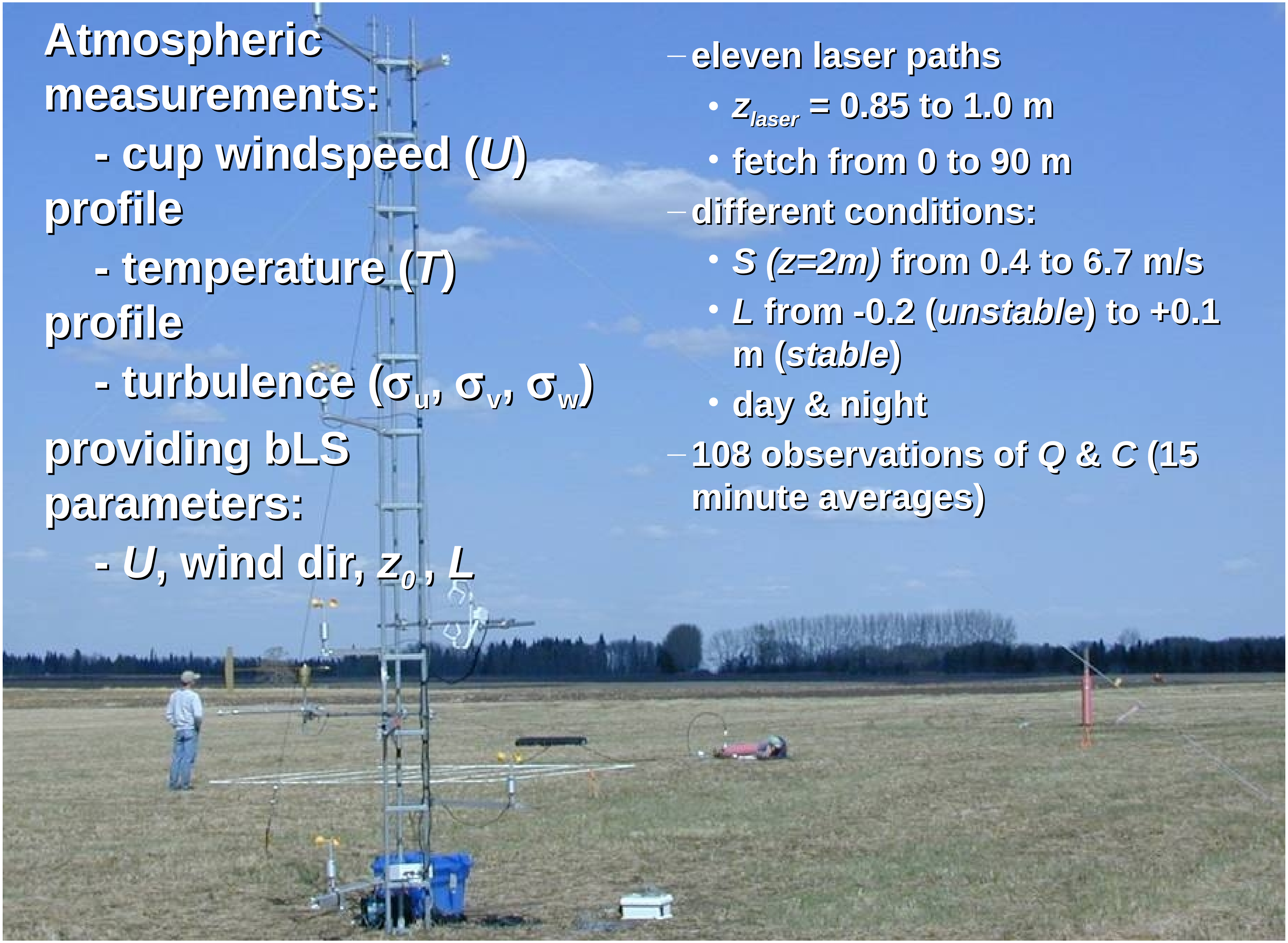
thus

$$Q^{bLS} = \frac{C - C_b}{\frac{1}{N_P} \sum \frac{2}{|w_0|}}$$

Verification in ideal setting: profiles on the infinite flat plain well known (Monin-Obukhov similarity theory -- lines on graphs)




reflectors
Concentration measured with open-path lasers, which give line-average concentration along path



Atmospheric measurements:

- cup windspeed (*U*) profile
- temperature (*T*) profile
- turbulence (σ_u, σ_v, σ_w)

providing bLS parameters:

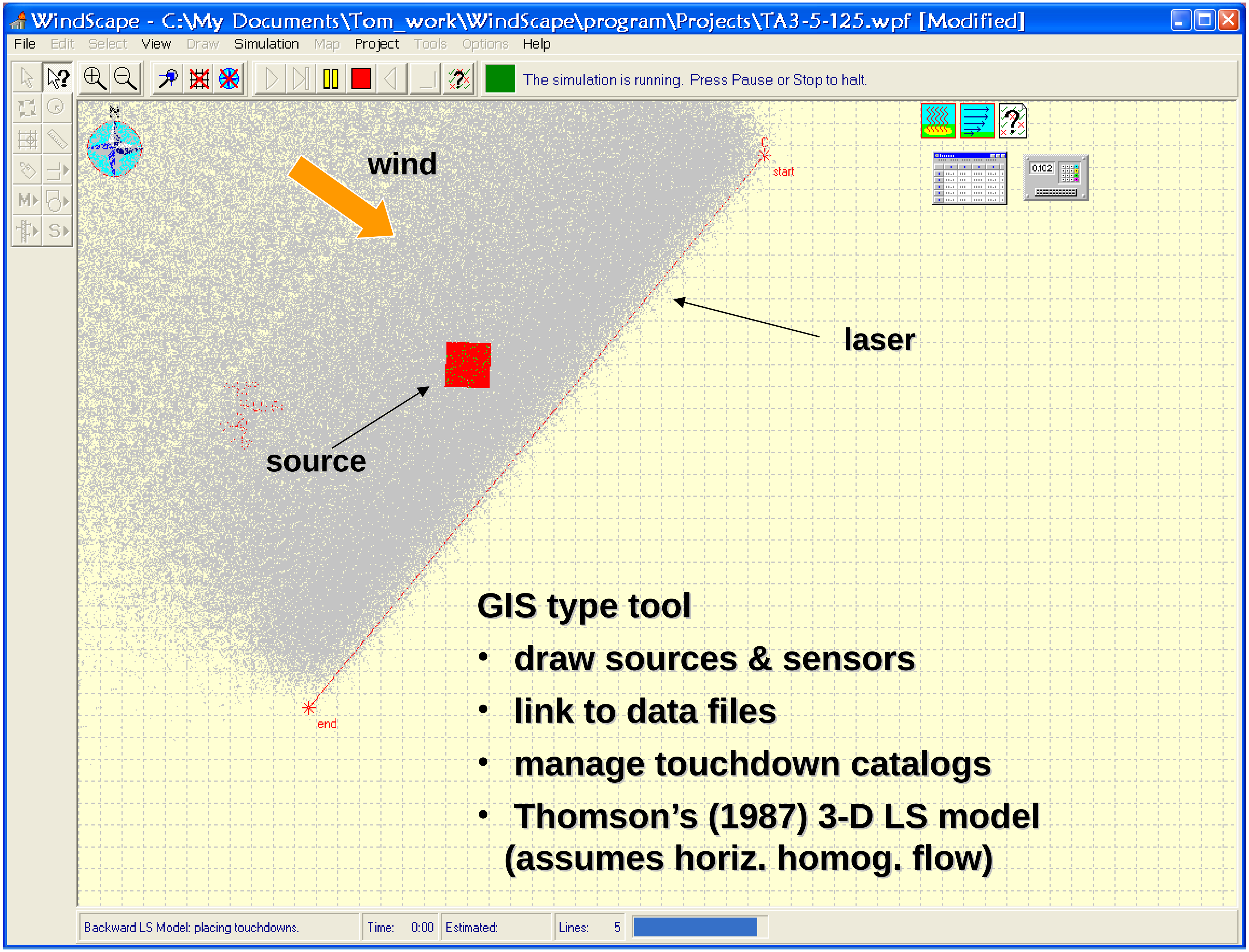
- *U*, wind dir, z_0, *L*

– eleven laser paths
  - z_{laser} = 0.85 to 1.0 m
  - fetch from 0 to 90 m

– different conditions:
  - *S (z=2m)* from 0.4 to 6.7 m/s
  - *L* from -0.2 (*unstable*) to +0.1 m (*stable*)
  - day & night

– 108 observations of *Q* & *C* (15 minute averages)

Brian Crenna's "WindTrax" for MO-bLS



GIS type tool

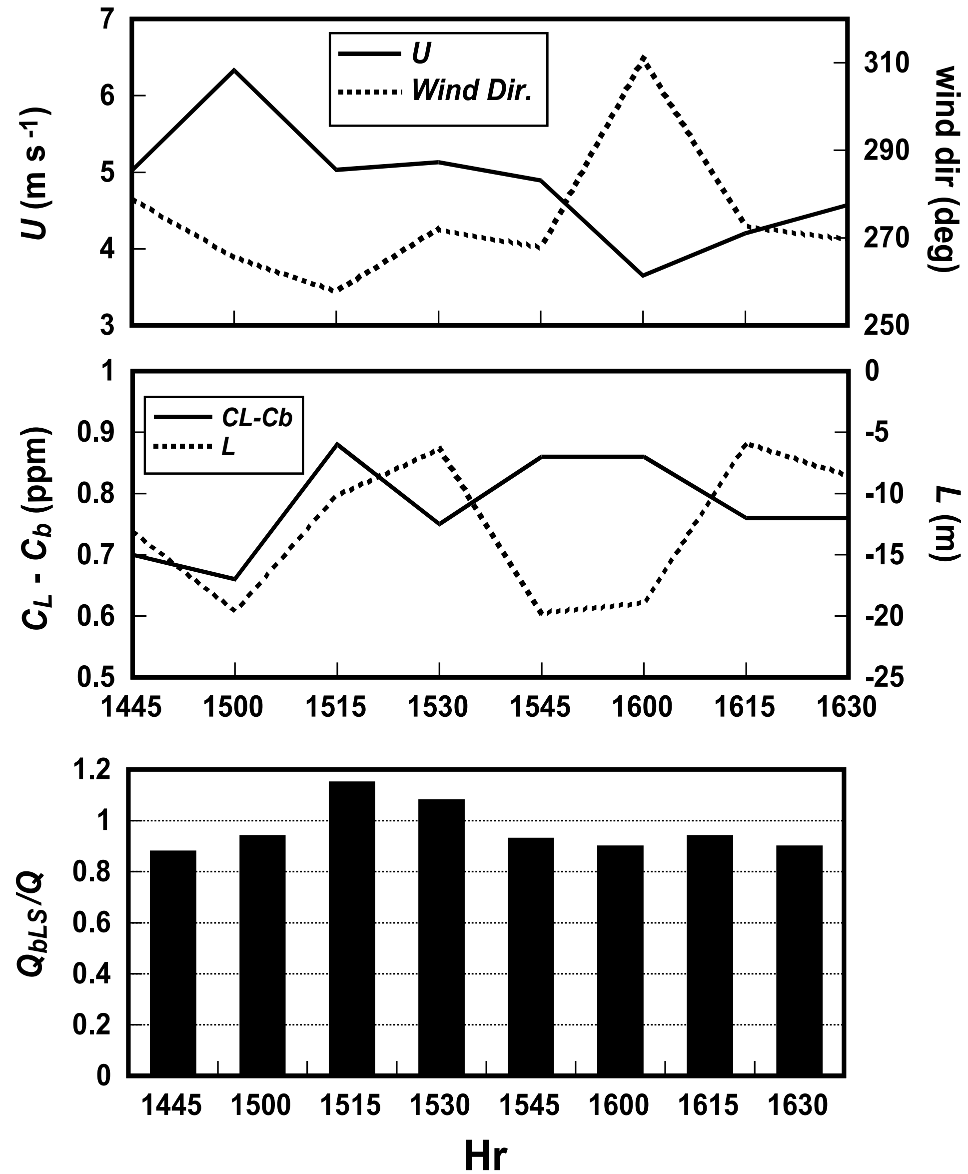
- draw sources & sensors
- link to data files
- manage touchdown catalogs
- Thomson's (1987) 3-D LS model (assumes horiz. homog. flow)

Performance of MO-bLS in ideal conditions

Reject periods when MOST does not fit profiles:

Q_{bLS} / Q averaged 1.02 (n = 77 obs. periods)

And $\sigma_{Q/Q} = 0.2$



bLS integrates changing winds with skill to yield accurate Q_{bLS}

Texas Feedlot: 47,000 cattle

Determining ammonia emissions from a cattle feedlot with an inverse dispersion technique

T.K. Flesch[a,*], J.D. Wilson[a], L.A. Harper[b], R.W. Todd[c], N.A. Cole[c]

Agricultural and Forest Meteorology 144 (2007) 139–155

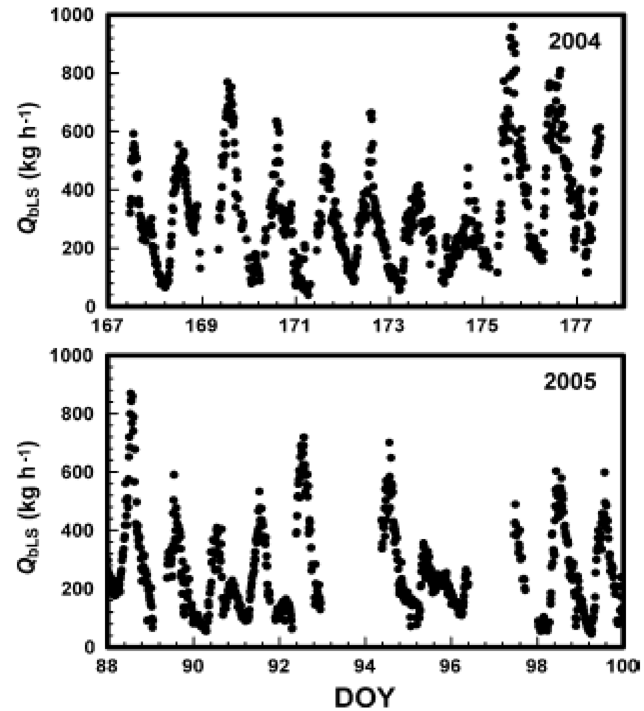
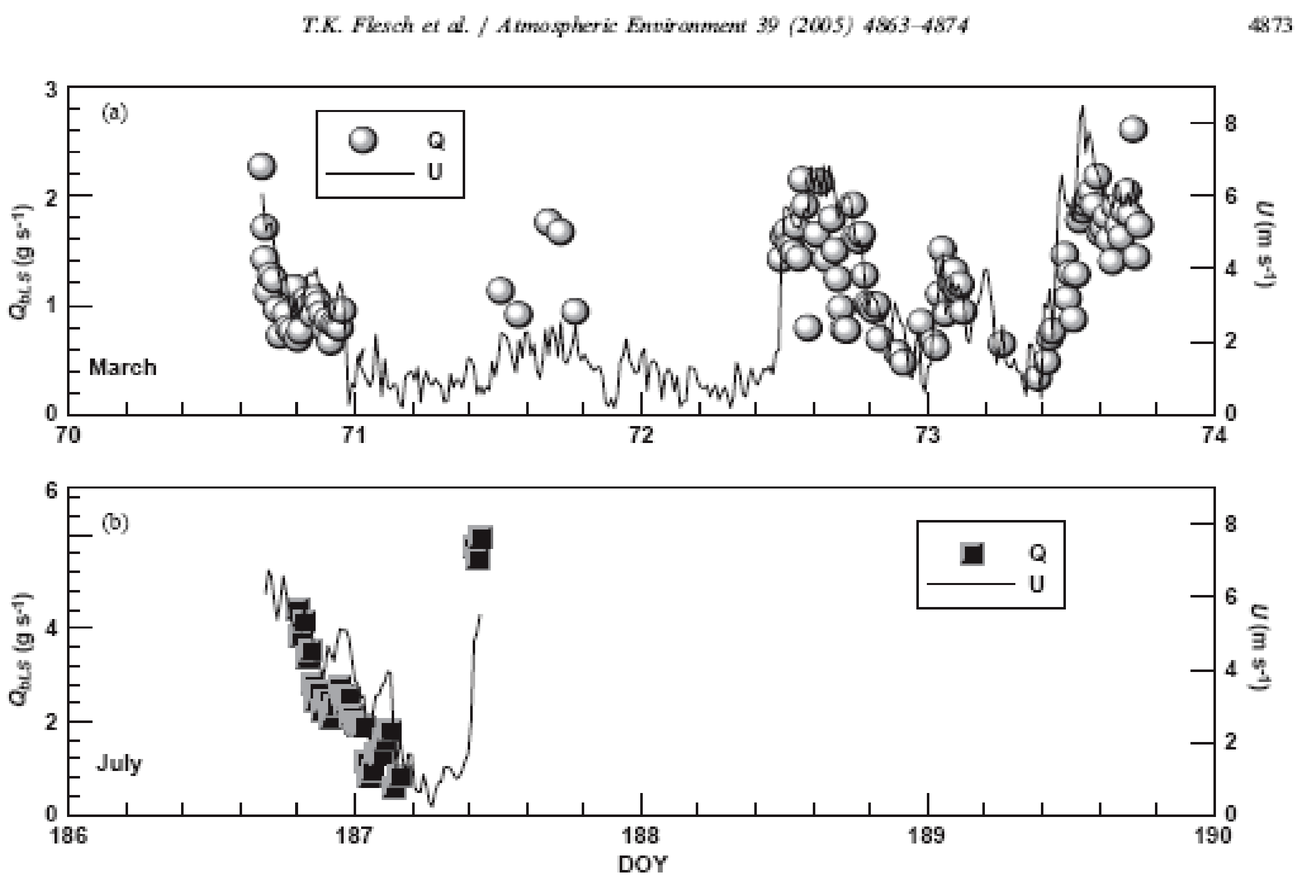


Fig. 9. Feedlot ammonia emissions Q_{bLS} plotted vs. day-of-year (DOY) for 2004 and 2005. Calculations are made using the in-feedlot measurements.

Emissions equate to 63 - 65% of dietary N in feed

Utah Swine farms - ammonia



“we calculated ammonia emissions of 6.5 and 16 g animal^{-1} day^{-1} in March and July, respectively”