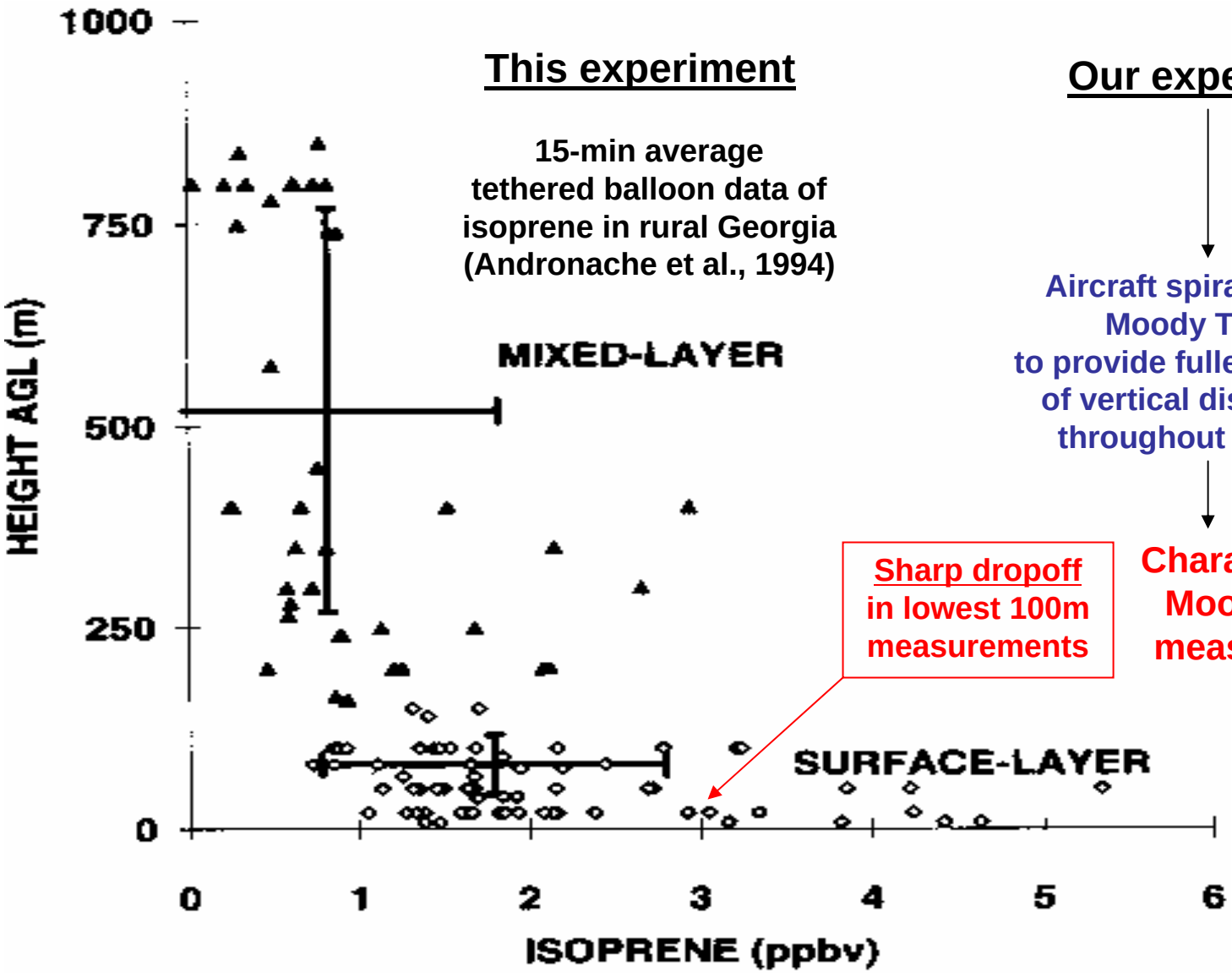
VERTICAL MIXING EXPERIMENT,

Objective(s) : To characterize the vertical distribution of tracer species (e.g., CO) and HRVOCs in the growing daytime CBL, for the purpose of development of improved parameterizations of vertical mixing in operational air quality models.



This experiment

15-min average tethered balloon data of isoprene in rural Georgia (Andronache et al., 1994)

Our experiment

Aircraft spirals above Moody Tower to provide fuller coverage of vertical distribution throughout the CBL

Characterized in Moody Tower measurements

Sharp dropoff in lowest 100m measurements

The Database

In-situ chemical and meteorological data

at two heights
(at Moody Tower, UH)
on four days

SO2, NOx, O3, CO, HRVOC data at two heights above ground :

HRVOC = **canister data at 40-min average ground level**

GC-FID and PTR-MS (averaged to 40-min)

and in Baylor aircraft on one day …… **Canister data and RAD + other data (CO, NOx, O3 etc)**

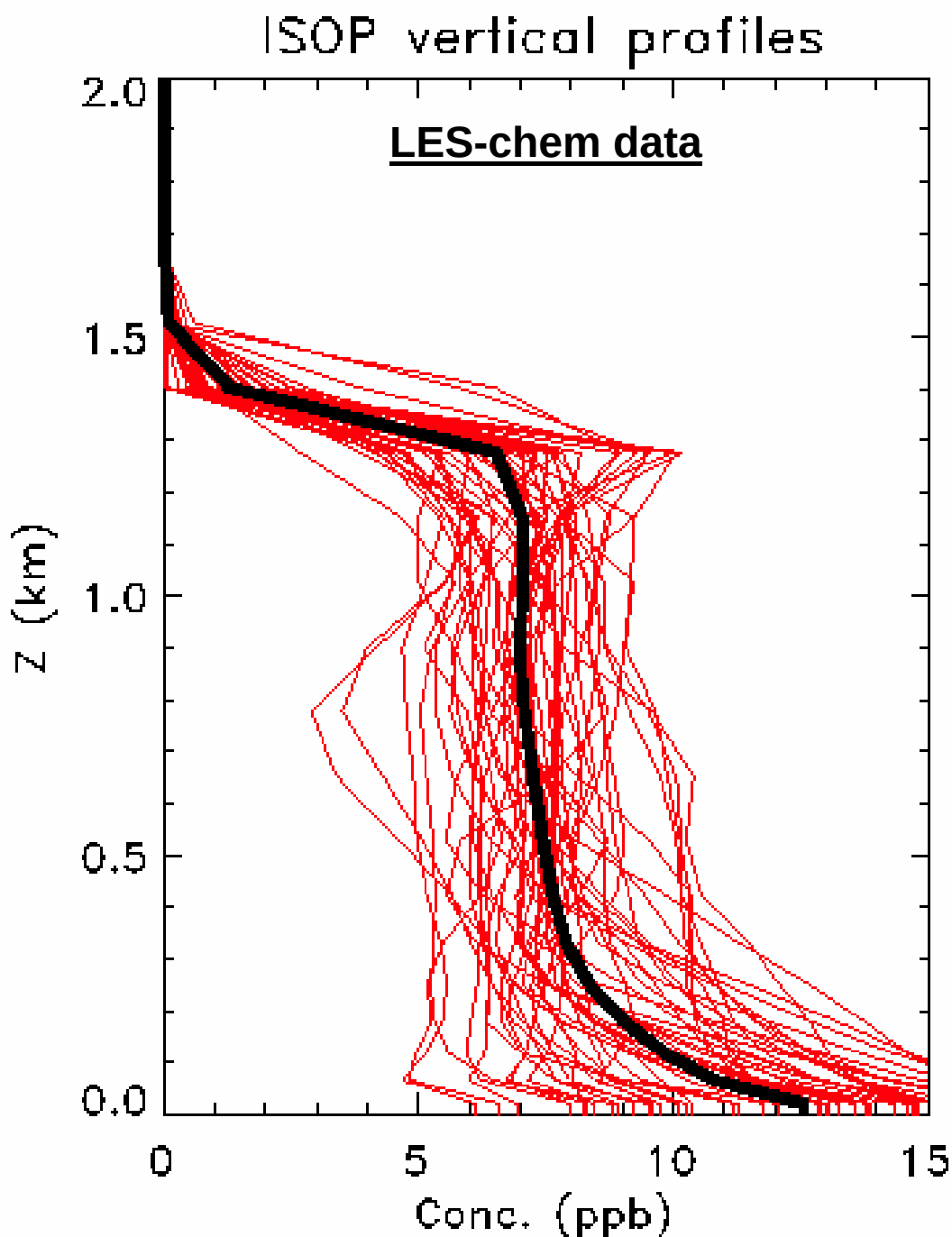
+ T, p RH, WS/WD at the two heights

+

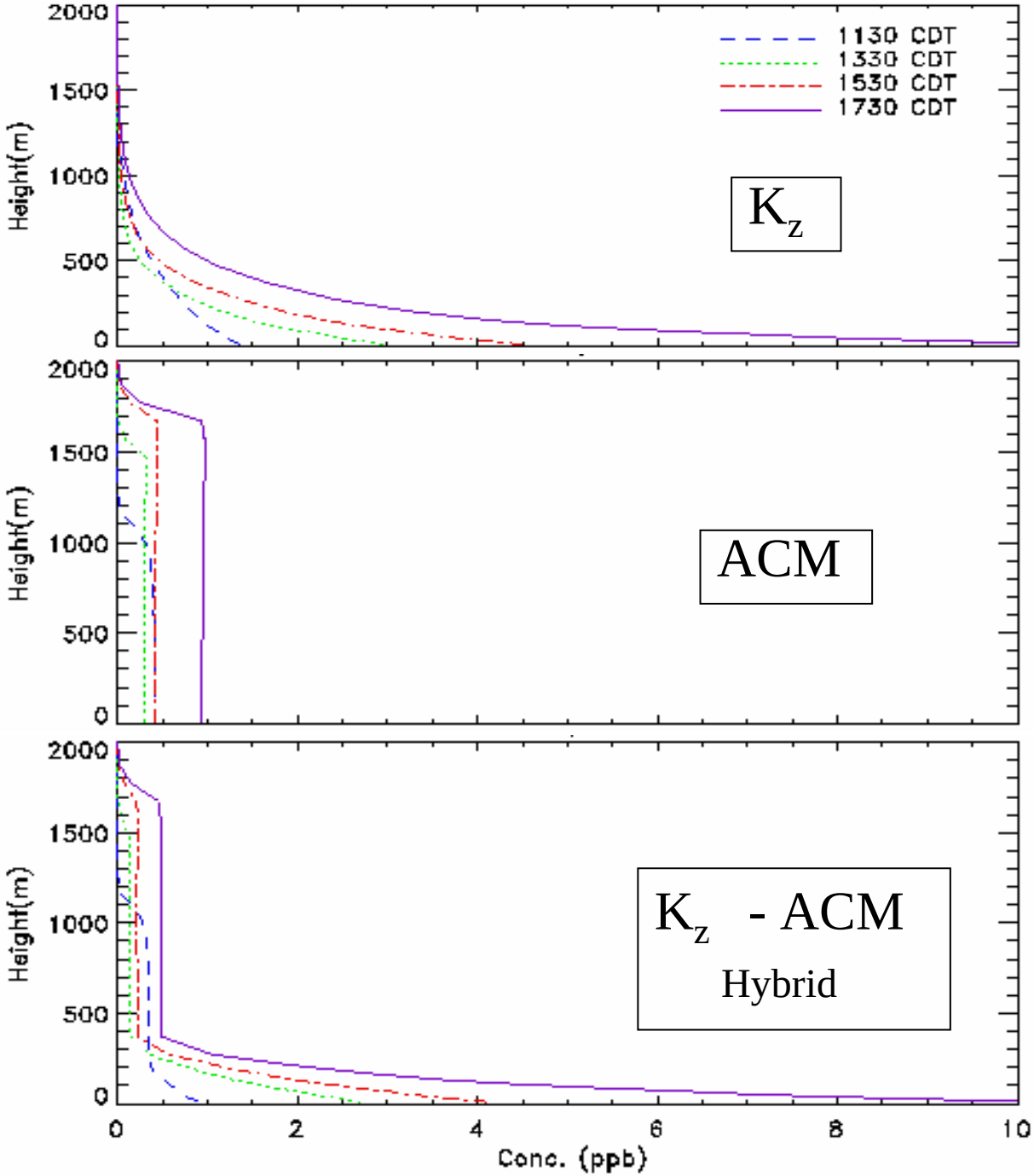
Tethersonde data — **T, p, RH, WS/WD, O3 at ~5m (1 s) resolution to ~300m**

Other soundings data ---------- **SODAR**
GPS radiosonde data
Ozonesonde

+ Max-DOAS (vert. Profiles data) of O3, SO2, NO2, HONO, HCHO



Midday vertical profiles of
CBL background concentrations
of isoprene in the vicinity of the
TVA Johnsonville power plant
on 23 June 1995
as calculated in LESchem ---
the red traces (50) are
instantaneous profiles
at 100s intervals, and
the bold black trace is
the 5000s average
over the same total period.



Vertical distributions of isoprene released from the surface into the CBL near the Cumberland power plant on a summer day, corresponding to three different models of boundary layer convection:

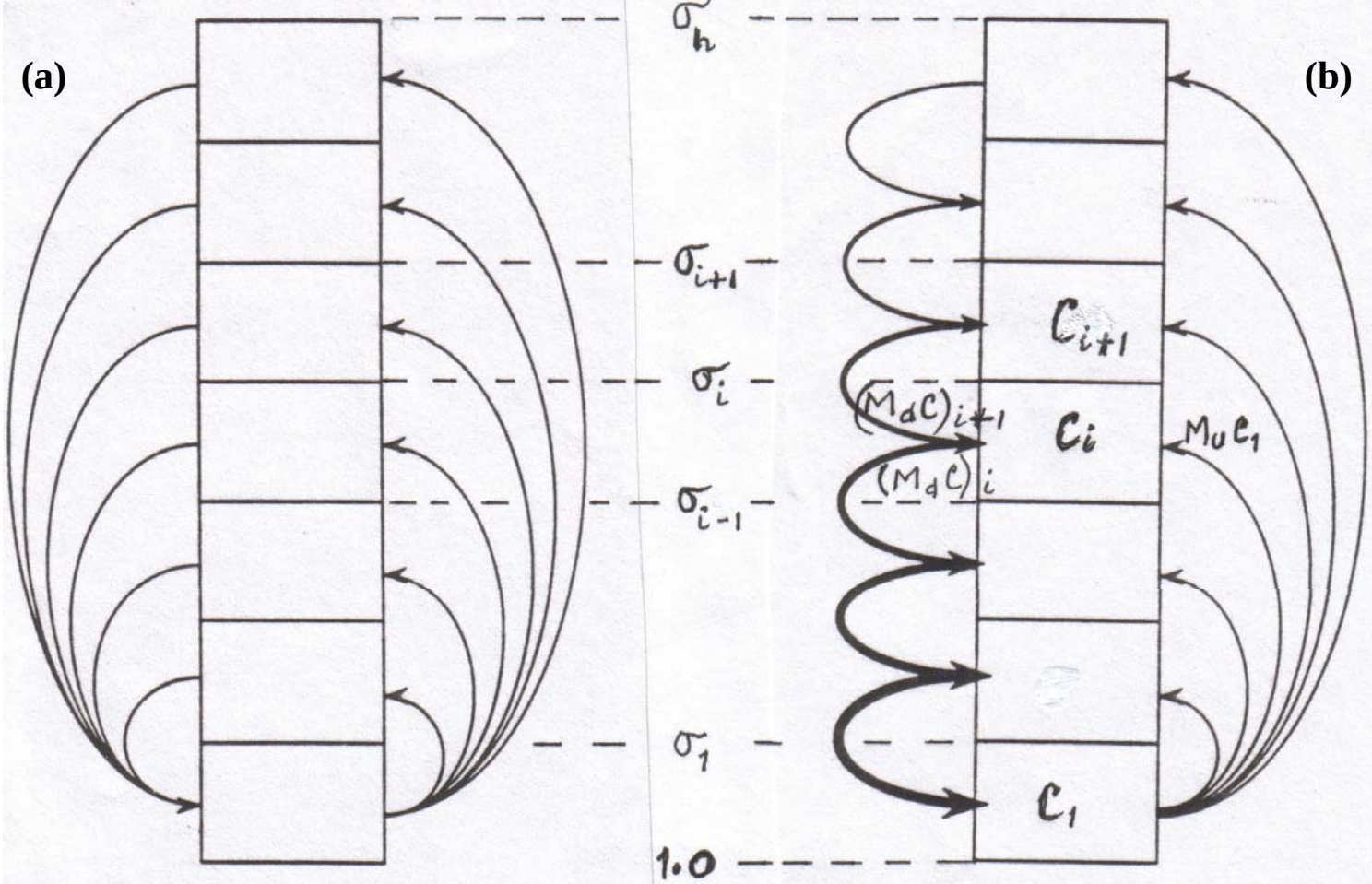
eddy diffusion (K_z),

ACM, and

hybrid of K_z and ACM.

In the hybrid model, K_z is used from the surface up to $0.15Z_i$, and ACM is used higher up.

The calculations were performed using LRPM-UAH.



Schematic representation of mixing in a 1-D column of air as simulated
(a) by the Blackadar Convective Model (BCM) of the boundary layer (vertically symmetric), and
(b) by the Asymmetric Convective Model (ACM).
BCM and ACM are two different examples of non-local closure approach (cells can communicate information not only to the immediately adjacent cells, but also to more distant cells), as opposed to the eddy diffusion model which is a local closure model (each cell can communicate only with the adjacent cells). In the ACM, updrafts can communicate to all cells above simultaneously, but downdrafts can only communicate in single-cell steps. In eddy diffusion, the downward diffusion is as in ACM, but the upward diffusion is also in single-cell steps; it is thus a local and symmetric model of diffusion. In (b) above, Mu represents the upward transfer rate of mass by diffusion from cell 1 to all cells above; Md is the downward diffusion rate between adjacent cells.

We will perform vertical dispersion based on

K_z, ACM, and Hybrid K_z+ACM

to simulate the observed distribution of CO and HRVOC.

The best vertical dispersion will be presented to HARC and TCEQ

for testing in CMAQ and CAMx.