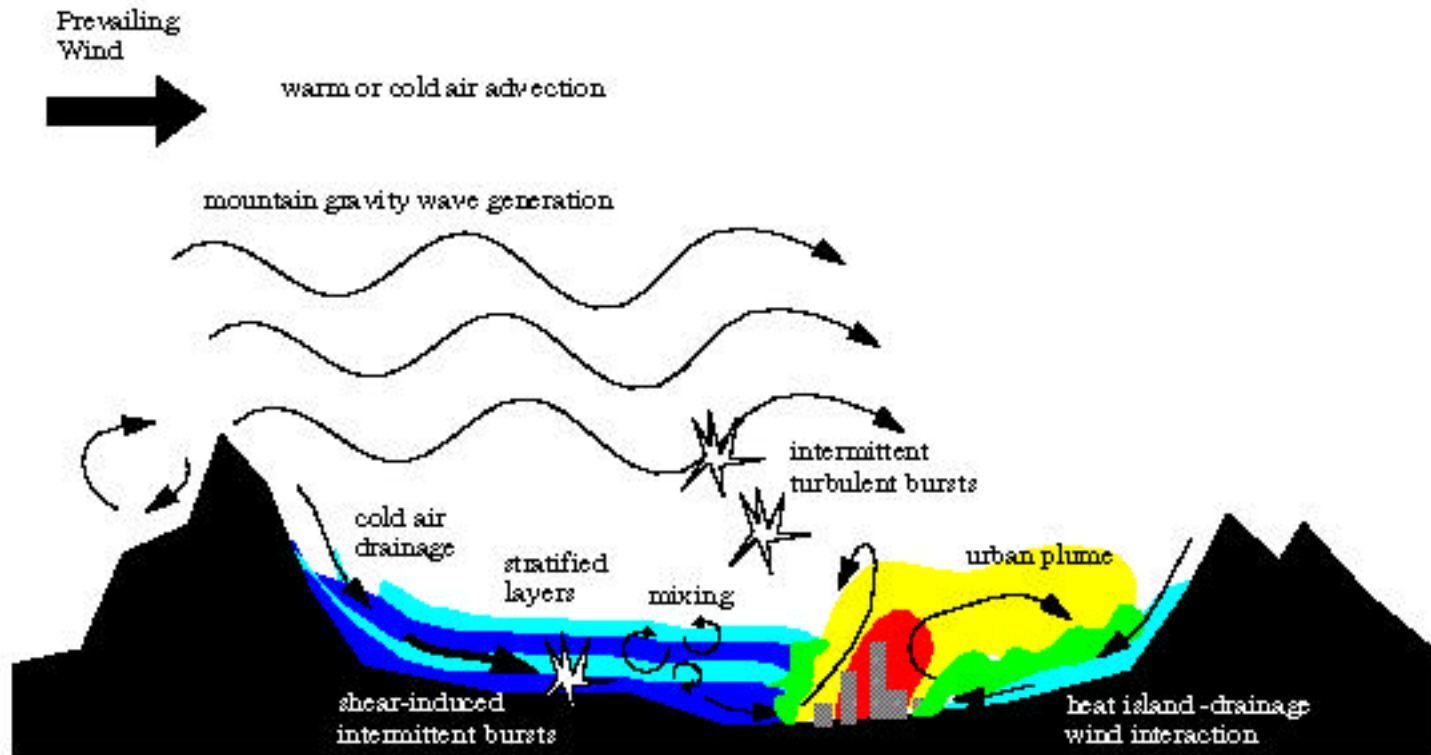# Stable Boundary Layer Flow Interactions in Urban Basins

James E. Bossert
Keeley R. Costigan
Michael J. Brown
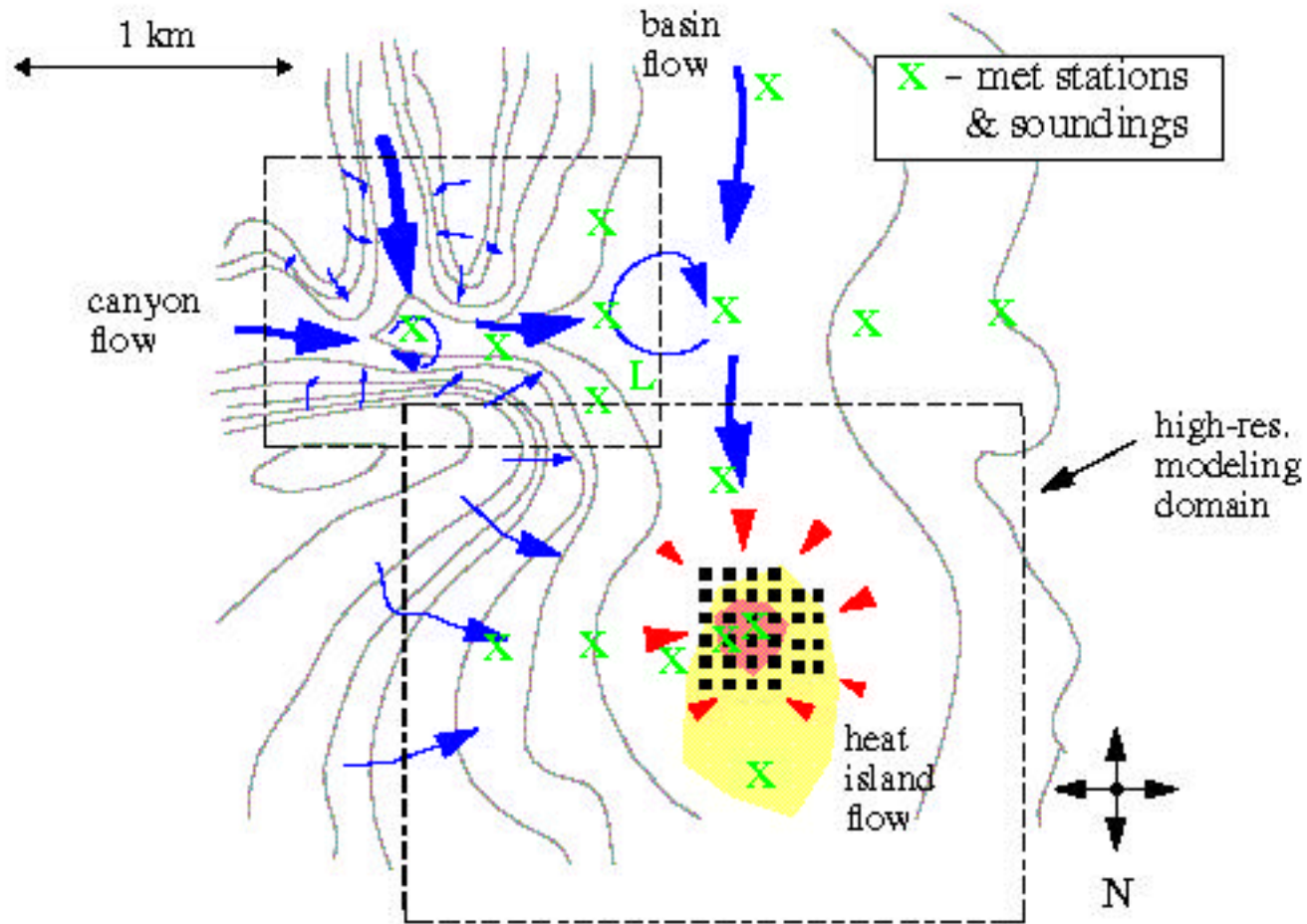
Los Alamos National Laboratory
Los Alamos, New Mexico

Current Investigations
Concepts for Future Studies

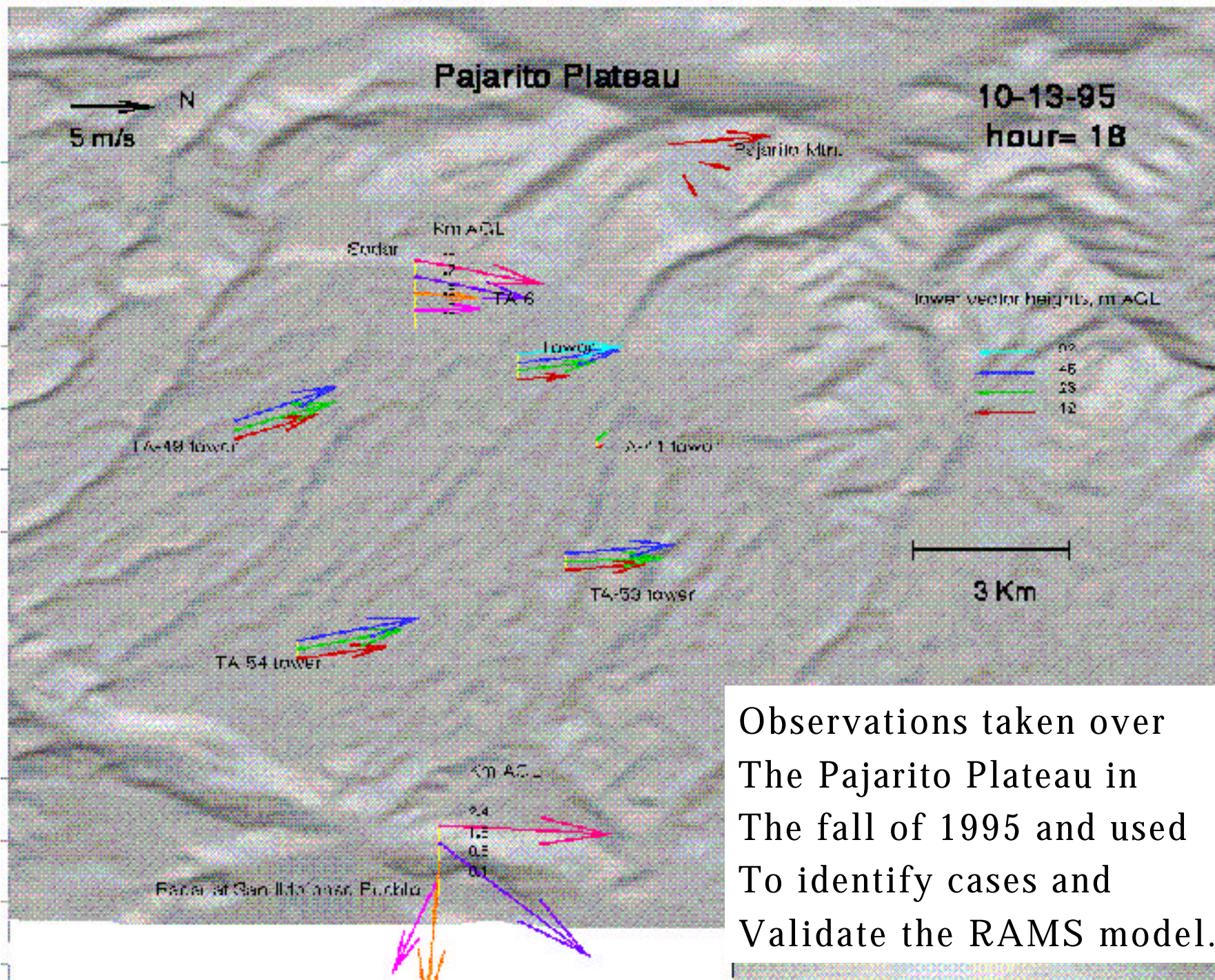**Schematic of Vertical Mixing-Inducing Phenomena Over a Basin**

Desired Measurement Strategy, Phenomenon of Interest, And Model Domains

Current Investigations

1) Los Alamos Multi-scale Flow Evolution

2) El Paso Transition Period Study

3) Urban Canopy Parameterization

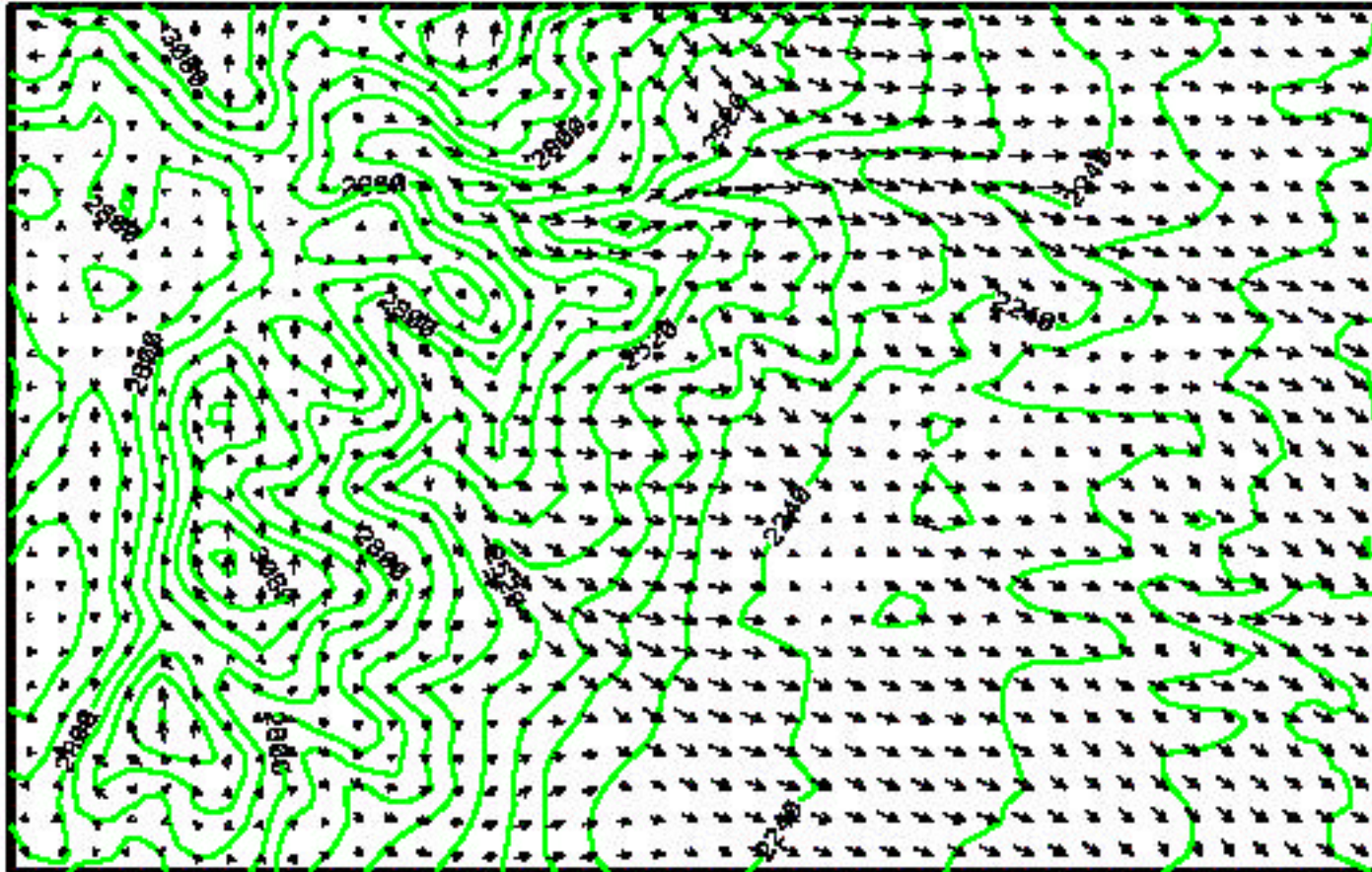4) Idealized Hi Resolution SBL Simulations

Observations taken over
The Pajarito Plateau in
The fall of 1995 and used
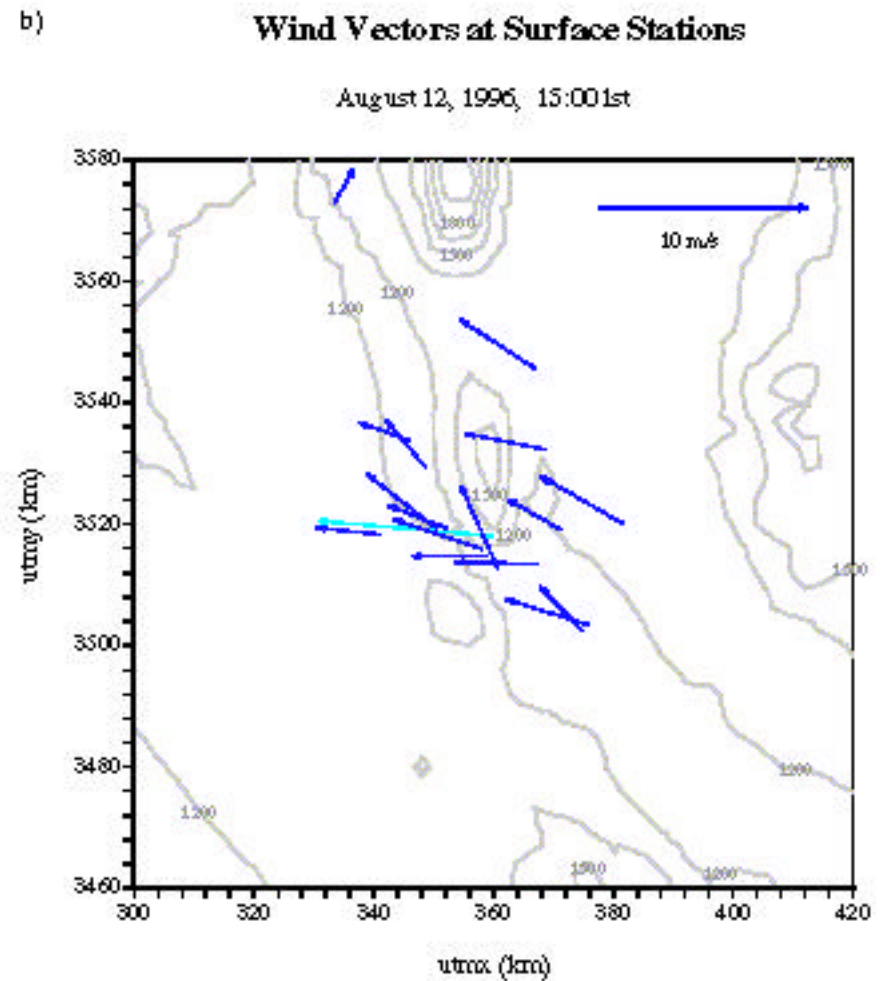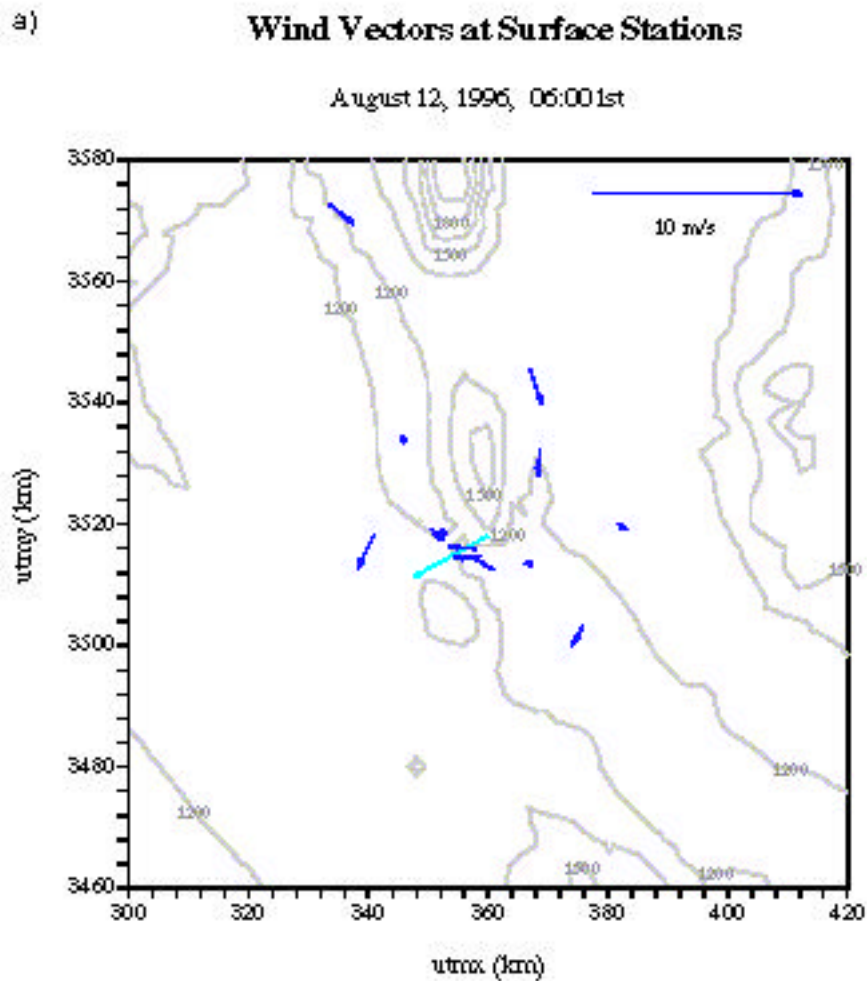To identify cases and
Validate the RAMS model.

Los Alamos Region Simulation
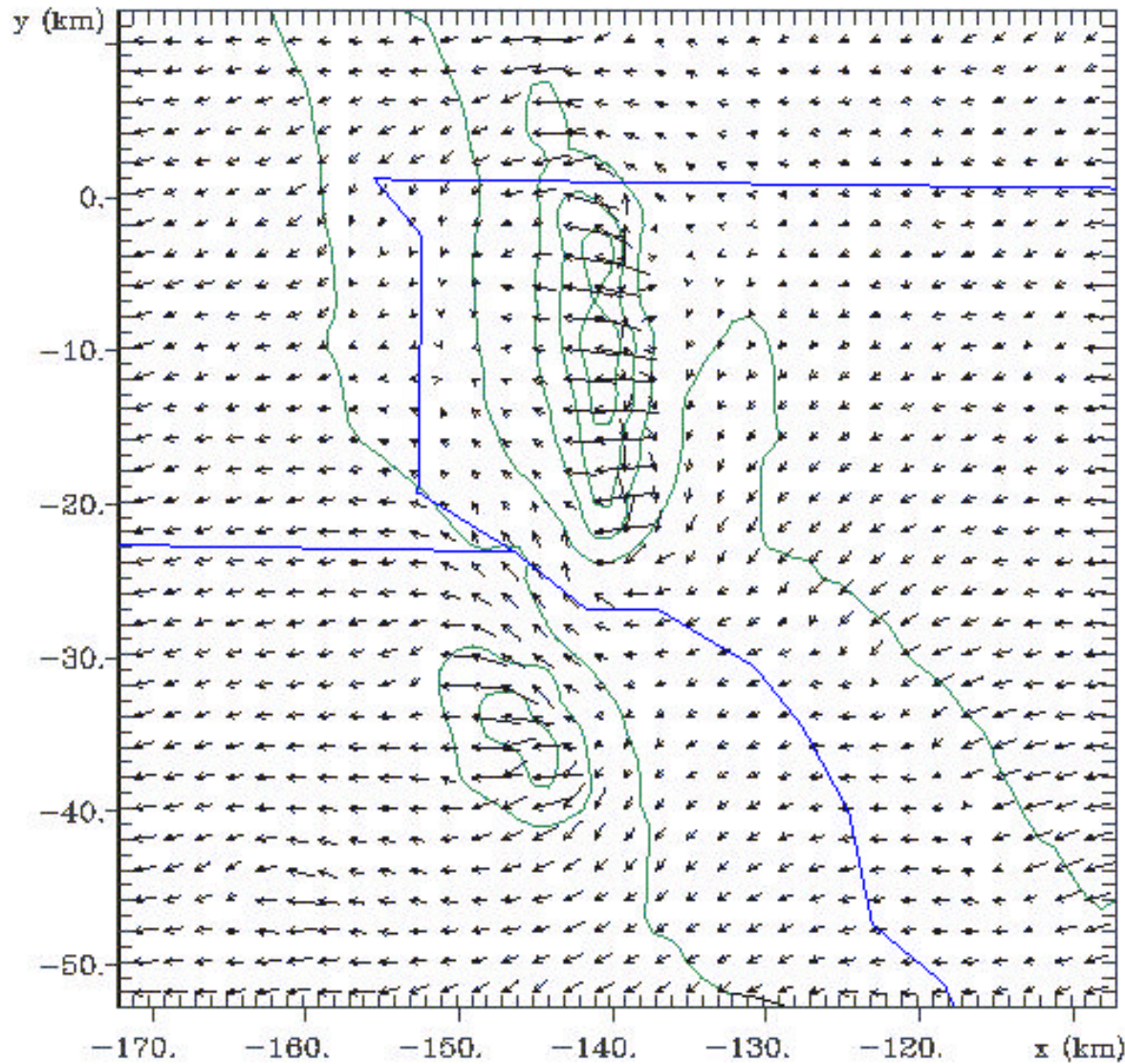

RAMS Grid 4 - 225 m horizontal resolution

Wind Vectors at 25 m at 0600 UTC 10-16-95

Observations from an intensive study in the El Paso region. Afternoon wind regime in b) corresponds to RAMS simulated result.
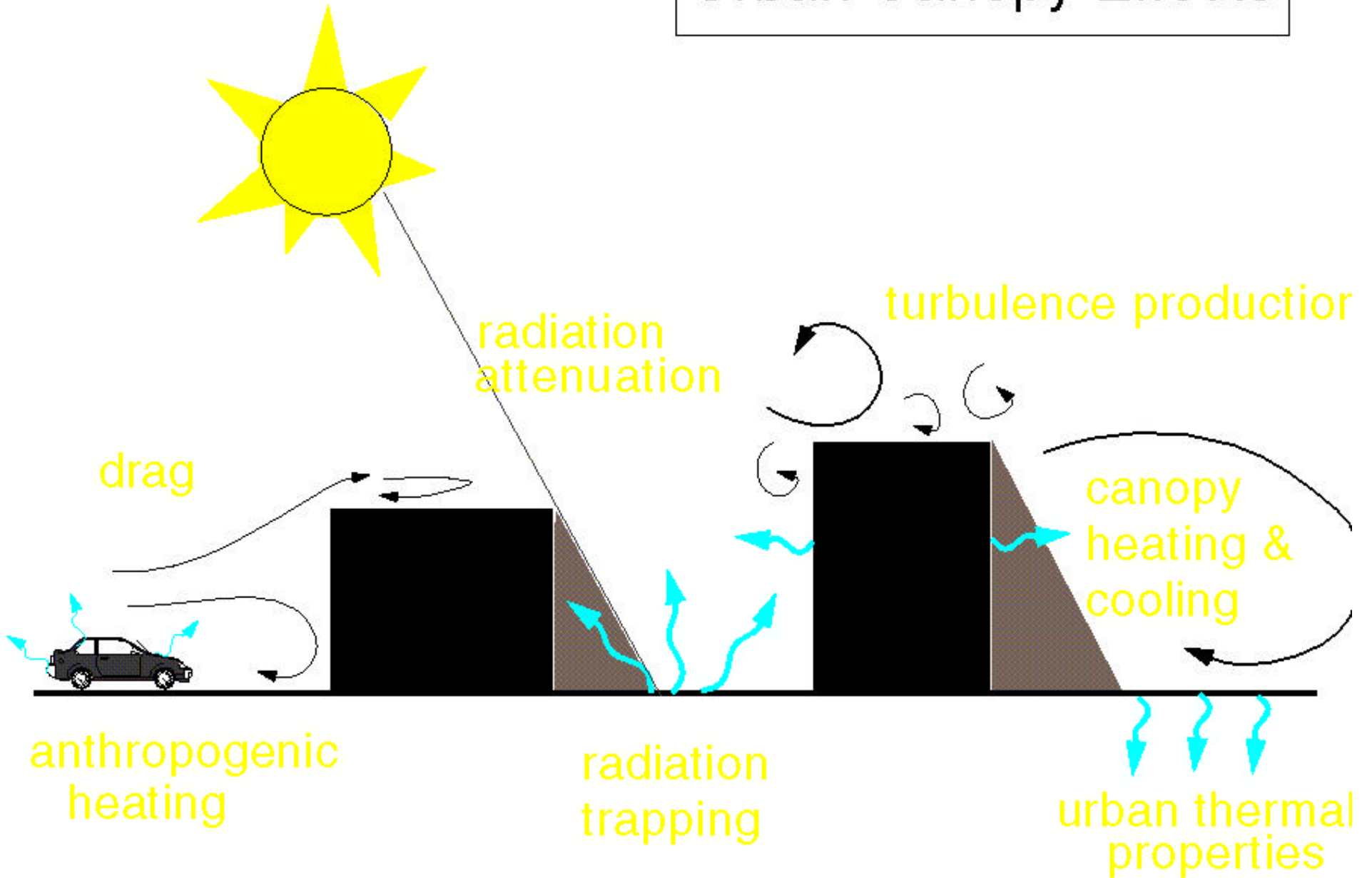
RAMS Simulation of the El Paso Area at 1 km Resolution

El Paso study		Grid 4			
z = 11.9 m	1996-08-12-1300 UTC 0 s	min	max	inc	lab*
contours	topo (m)	1300.	1860.	150.0	1c 0
vectors	→ 5.0 m/s horiz 5.00 m/s vert				

Axis labels: y (km), x (km)

Urban Canopy Effects

radiation attenuation

turbulence production

drag

canopy heating & cooling

anthropogenic heating

radiation trapping

urban thermal properties

vertical profiles within city to capture
urban heat island dome and downwind plume:

1) temperature
2) wind speed and wind direction
3) turbulent kinetic energy
4) relative humidty

craft flights - horizontal
verses:

temperature
ws and wd
vertical velocity
tke

tower measurements at urban-rural interface:
conditional sampling based on wind direction will
allow for area-average urban-rural differences to be
accounted for.
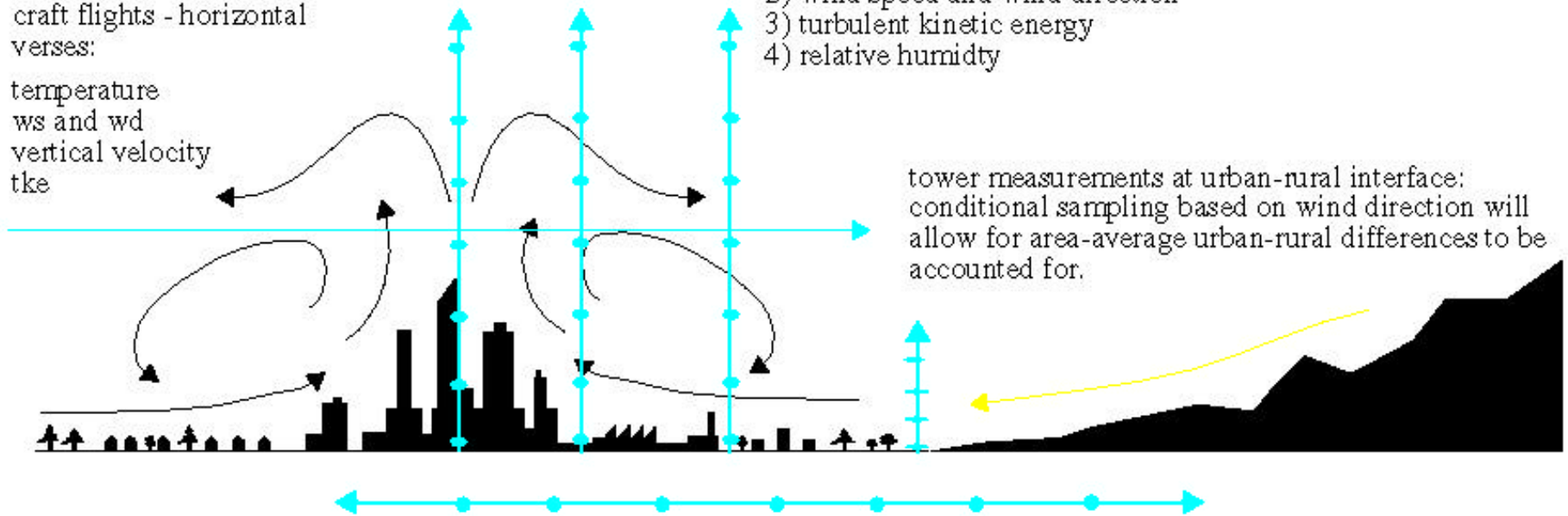
surface met stations to capture horizontal gradients and
heat island-mountain drainage flow interaction

1) skin, 5, 10, & 25 meter temperatures
2) sensible and latent heat flux
3) turbulent kinetic energy
4) wind speed, wind direction, & relative humidity
5) short and longwave fluxes
6) soil heat flux
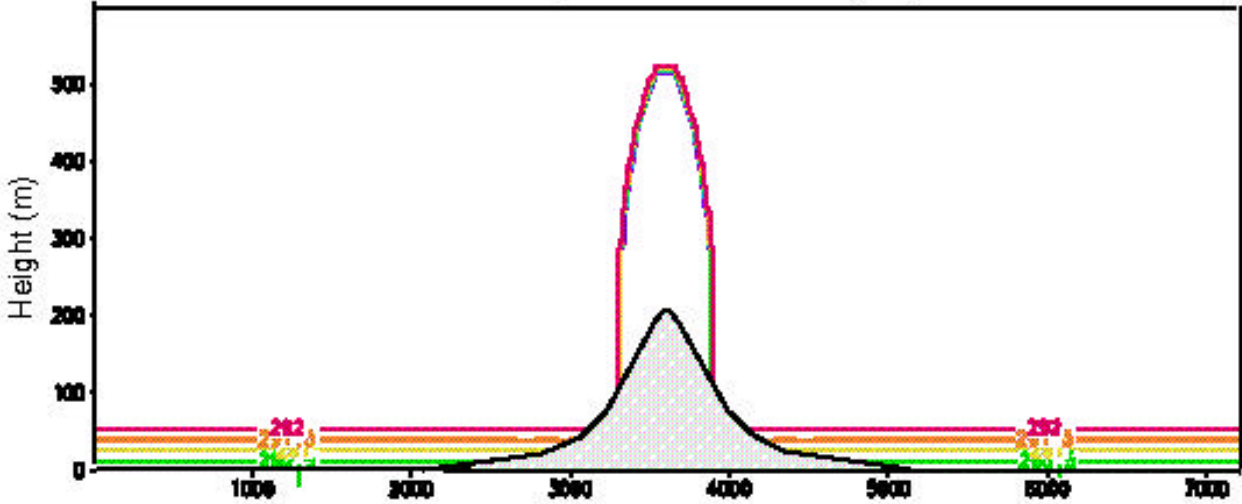
Tracer Release in an Urban Environment with HIGRAD Model

Concentration

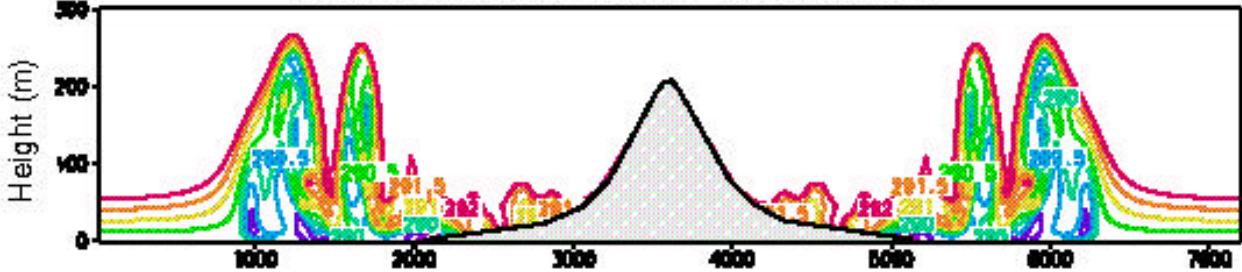0.0000   0.0013   0.0026   0.0039
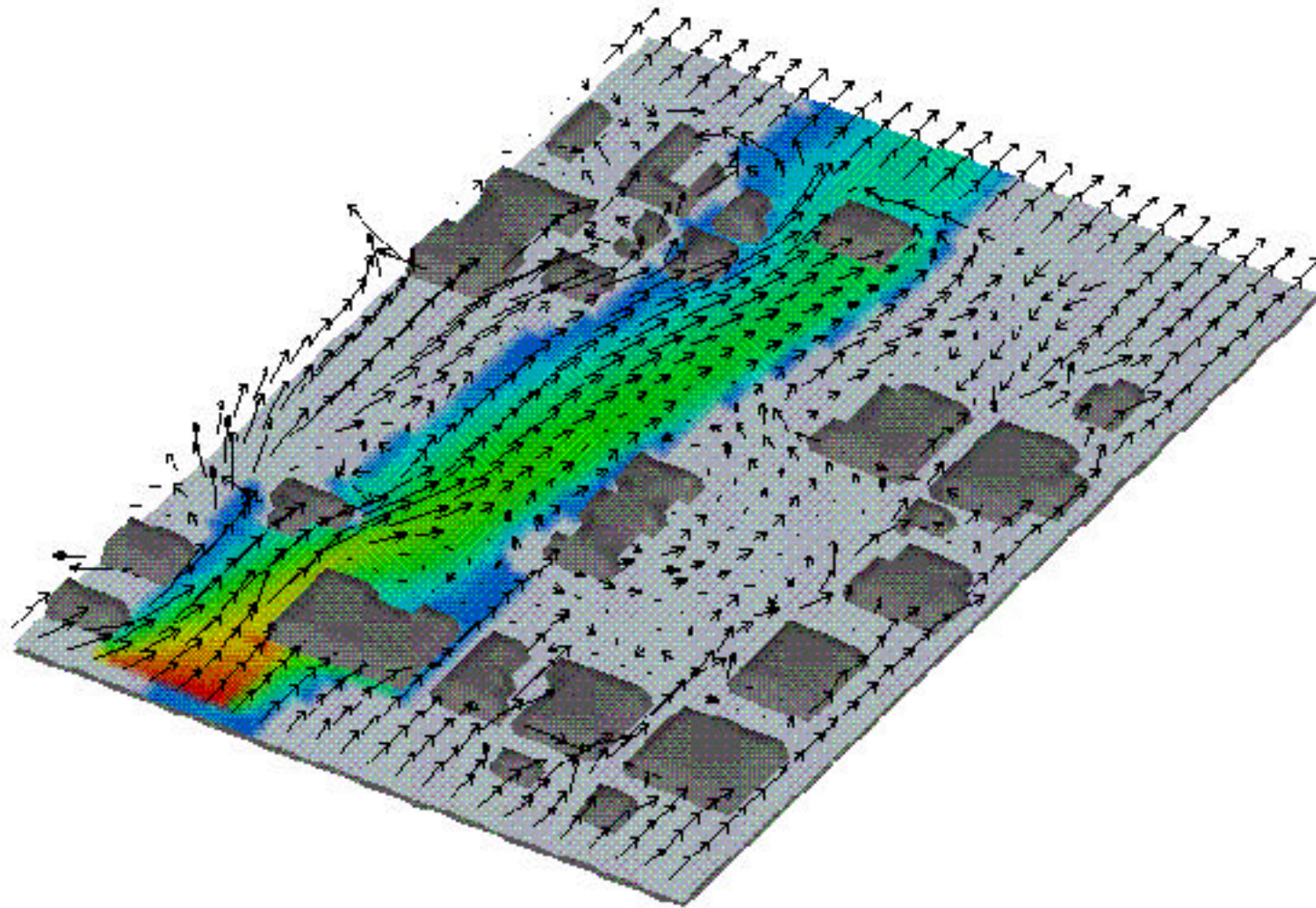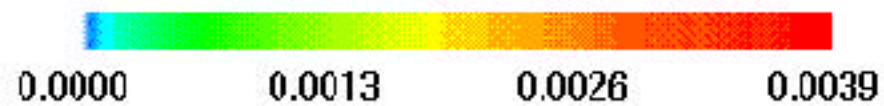
High Resolution Density Current Simulations with Two Models
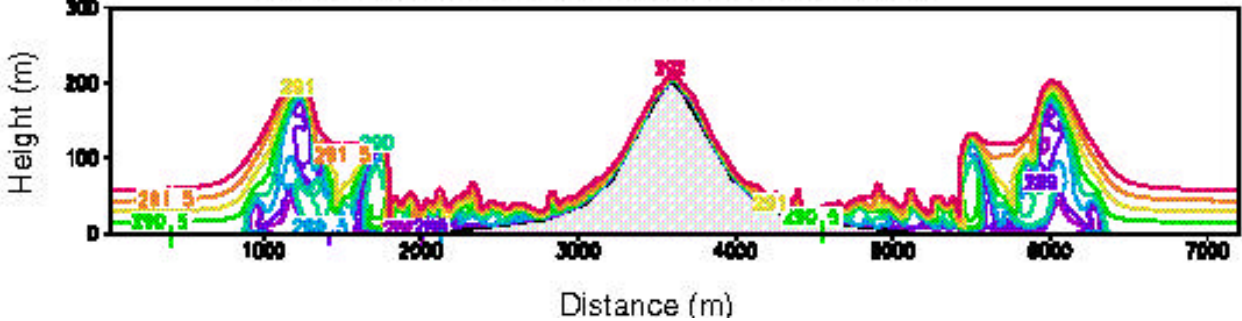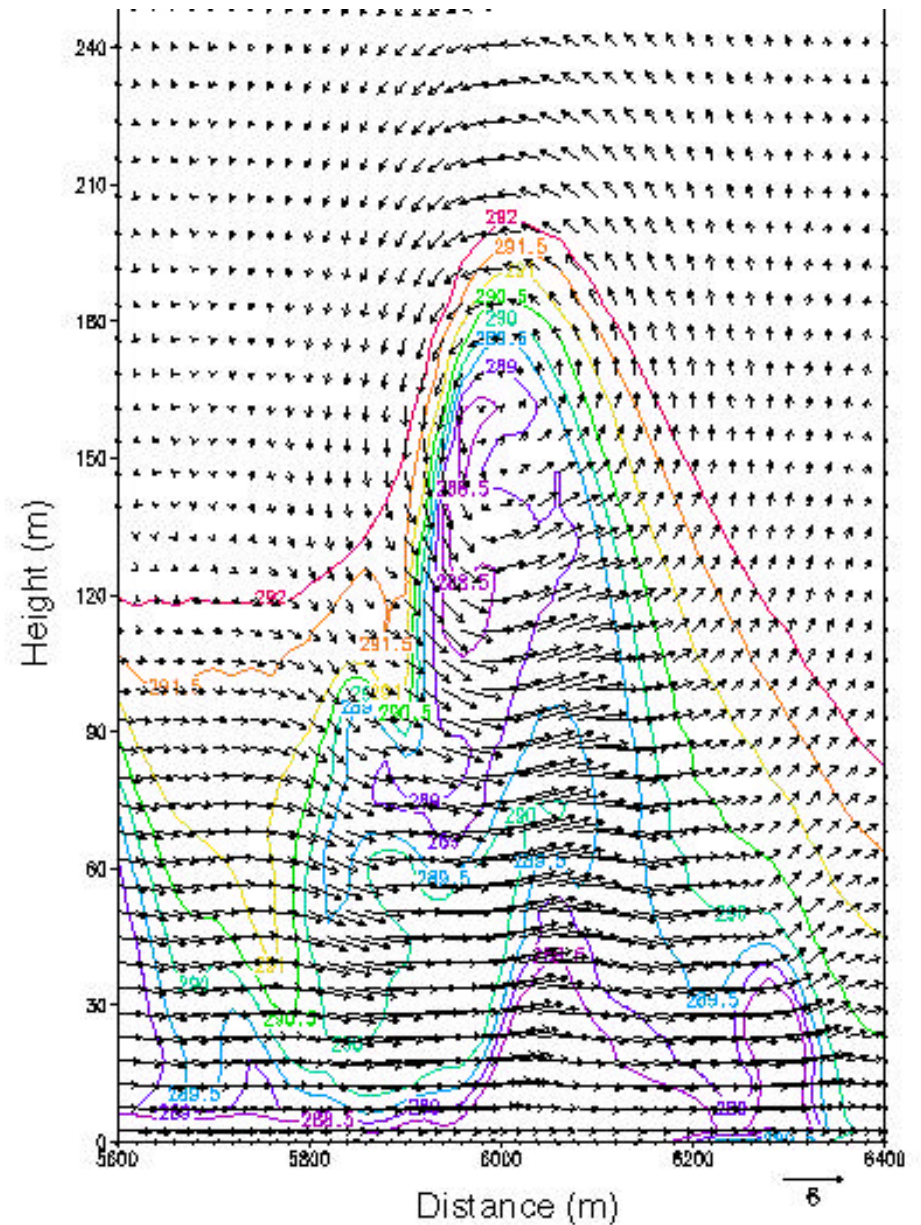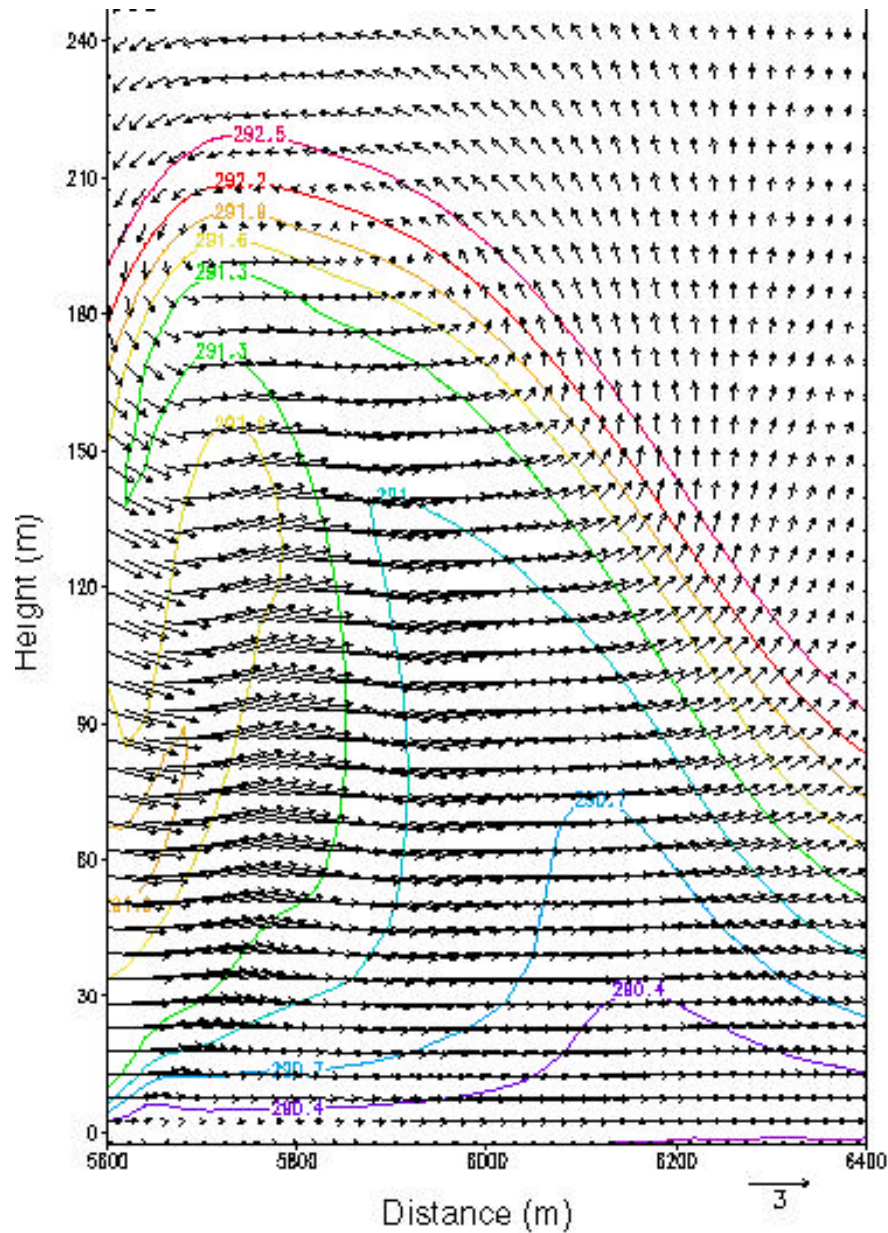

Initial Temperature Deficit (5 K)

RAMS simulation after 9.5 minutes

HIGRAD simulation after 9.5 minutes

Internal bore simulation comparison between the RAMS and
HIGRAD models at 20 m horizontal resolution, 5 m vertical.

Summary

Initial emphasis for VTMX Program

- Katabatic flow evolution and interaction, especially along urban perimeter

- Urban canopy parameterizations for SLC

- Regional advection processes