

**VERTICAL TRANSPORT AND
MIXING IN COMPLEX-TERRAIN
AIRSHEDS**



By

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Plan:

Identify and study salient fluid dynamic processes pertinent to complex-terrain meteorology

- Laboratory experiments
- Theoretical analysis
- Field experiment data
(Phoenix Air Flow Experiments I and II
VTMX Field Experiments – Limited Participation)
- Numerical modeling

Laboratory Experiments

Two types of topography

- Simple planar topography with roughness elements
 - Two-dimensional basin

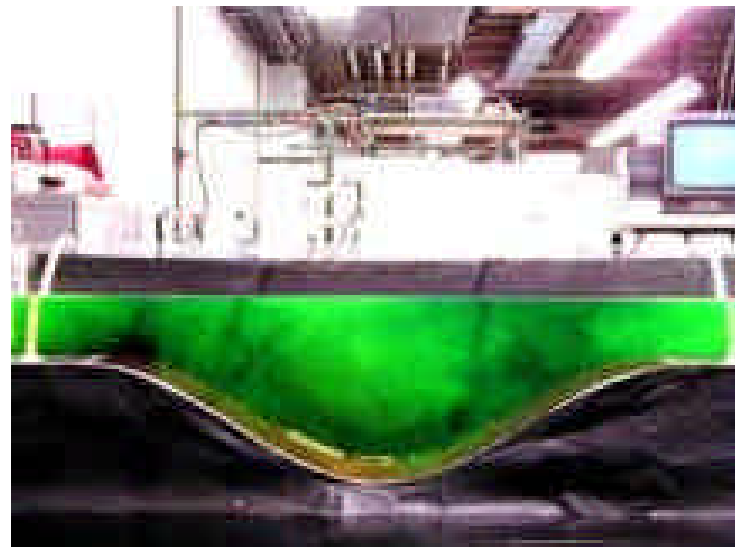
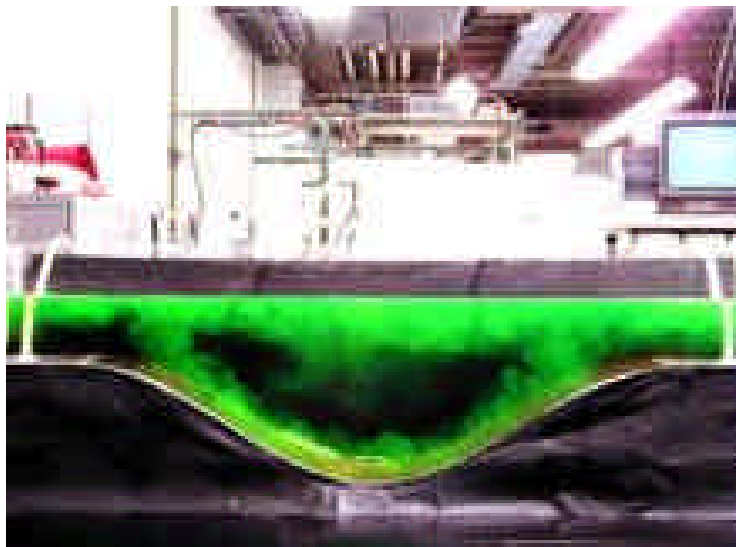
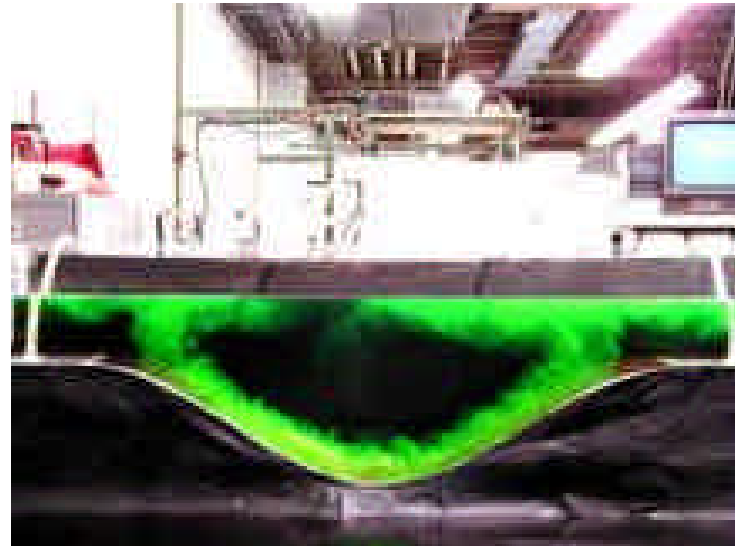
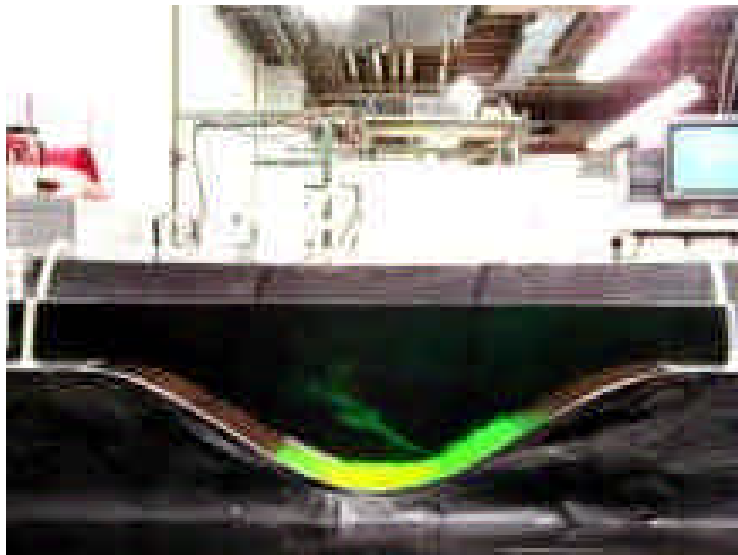
Uniform and sinusoidally varying heat flux (heating and cooling)

Establish:

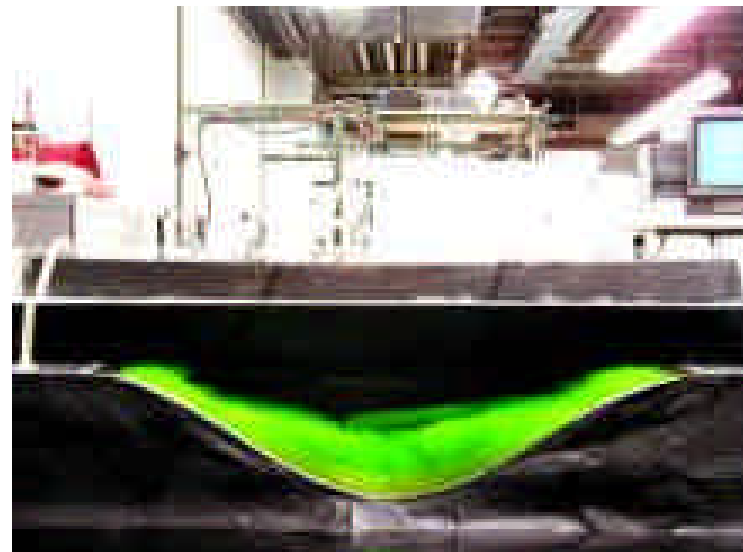
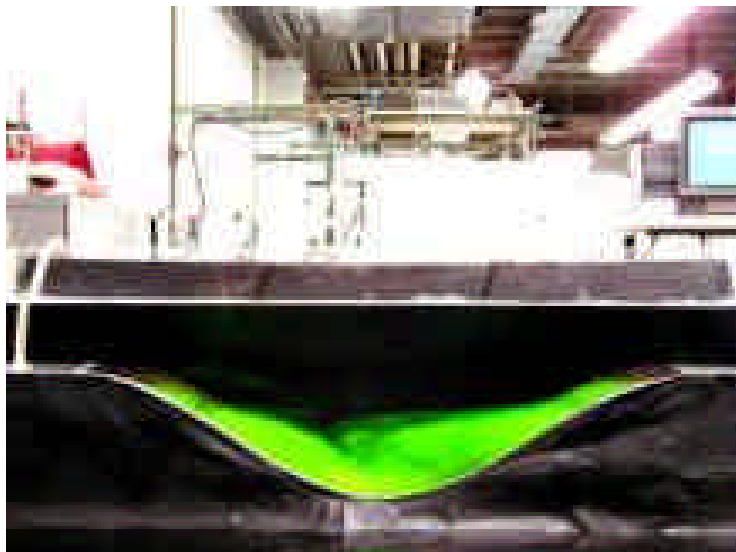
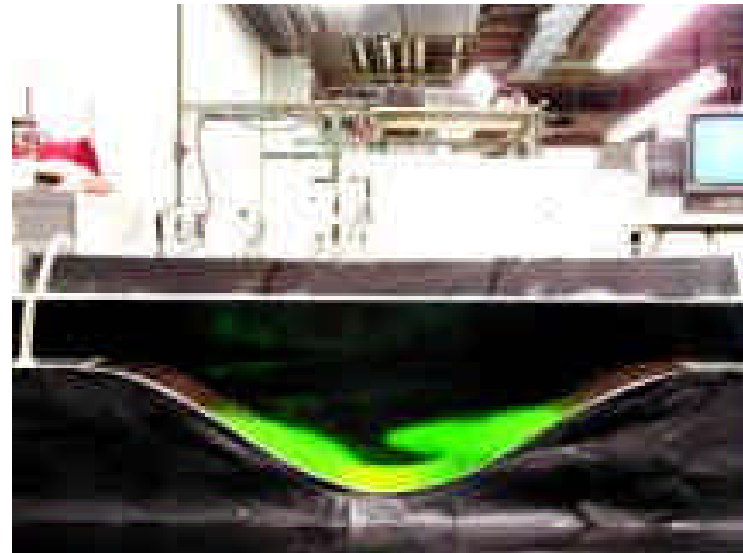
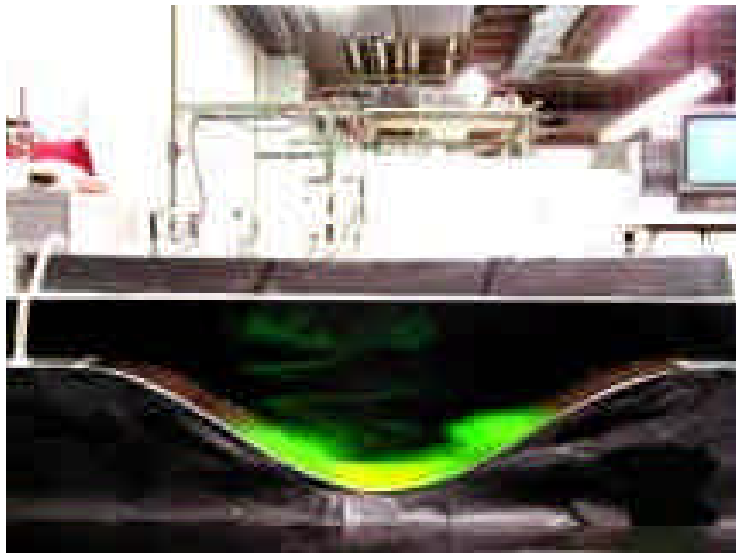
- Time scale for flow establishment
- Entrainment into katabatic and up-slope flows
- Self similarity of profiles
- Momentum balances
- Internal hydraulic behavior
- Cold pool formation
- Transition from cooling to heating and vice versa
- Cold pool break-up process (verification of Whiteman's scenario)

The results of the laboratory experiments will be compared with those of Whiteman & Zhong that will be taken under the VTMX program (Similar experiments – Phoenix?)

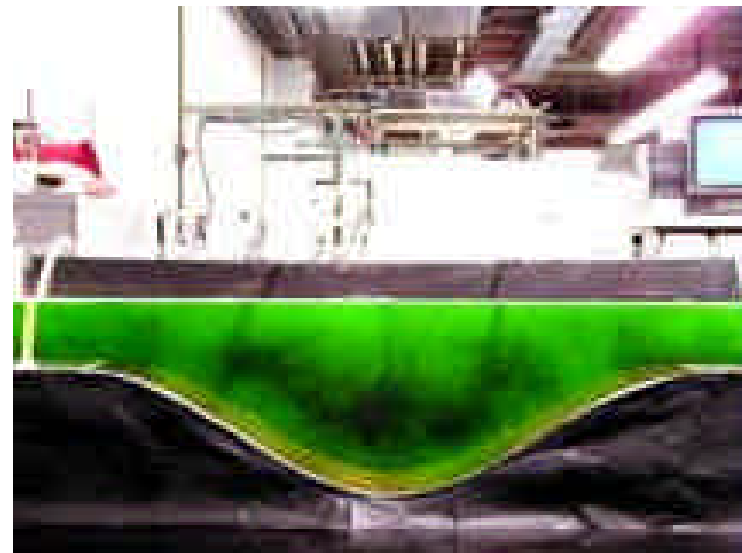
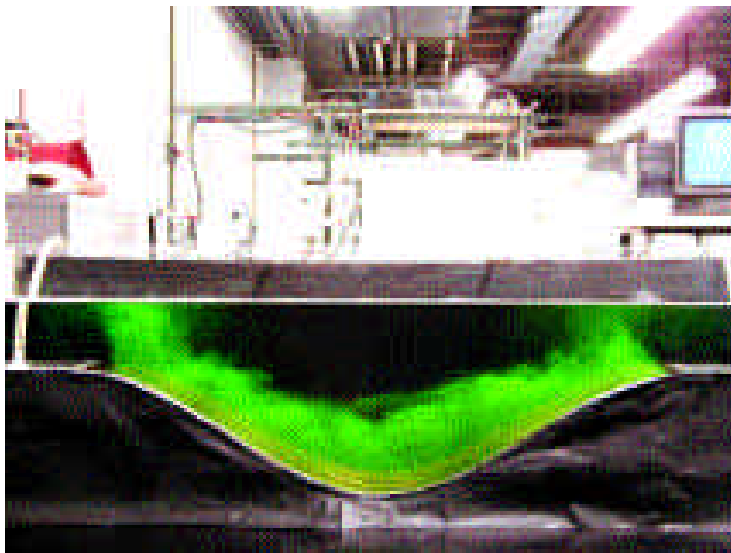
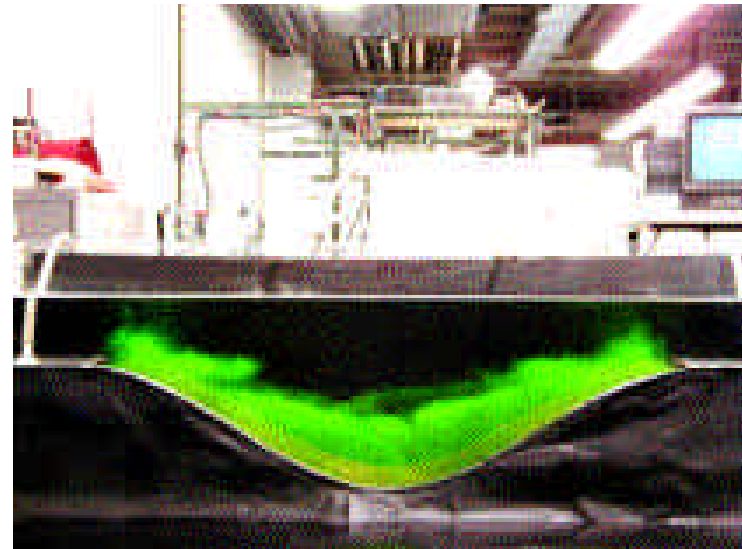
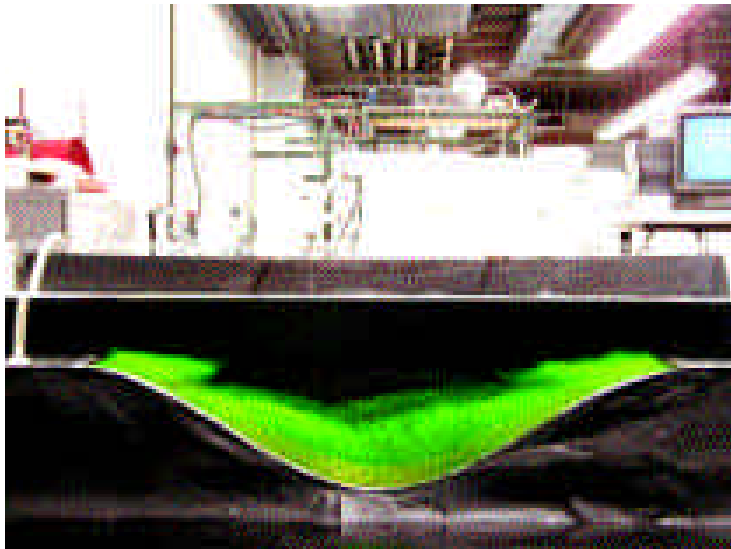
Laboratory simulation of upslope winds – Homogeneous case



Laboratory simulation of upslope winds – Stratified case, page 1



Laboratory simulation of upslope winds – Stratified case, page 2



Field Experiments

We will continue to analyze field data taken during PAFEX I and PAFEX II (supporting role for field experiments).

- Transition data
- Turbulence under stratified and convective conditions
(will collaborate with Carmen Nappo and Will Shaw)
- Contaminant transport data

We will participate in VTMX field experiments

Vertical profiling of ABL under stable and unstable conditions (1-week) –
meteorological tower

- Wind velocity and direction
 - Relative Humidity
 - Temperature
- 3-D sonic Anemometers at two levels (7.5 m and 15 m)
- Turbulence and evolution
- Streaker Instrument (Vertical Sampling of Aerosols)
- SEM analysis – back trajectories and identify sources

Measurement site



PHOENIX AIR-FLOW EXPERIMENTS

PAFEX-I – January 14 – January 31, 1998

PAFEX-II – July 1 – September 15, 1998

Winter Experiment:

Particulate and CO concentrations (Convective conditions)

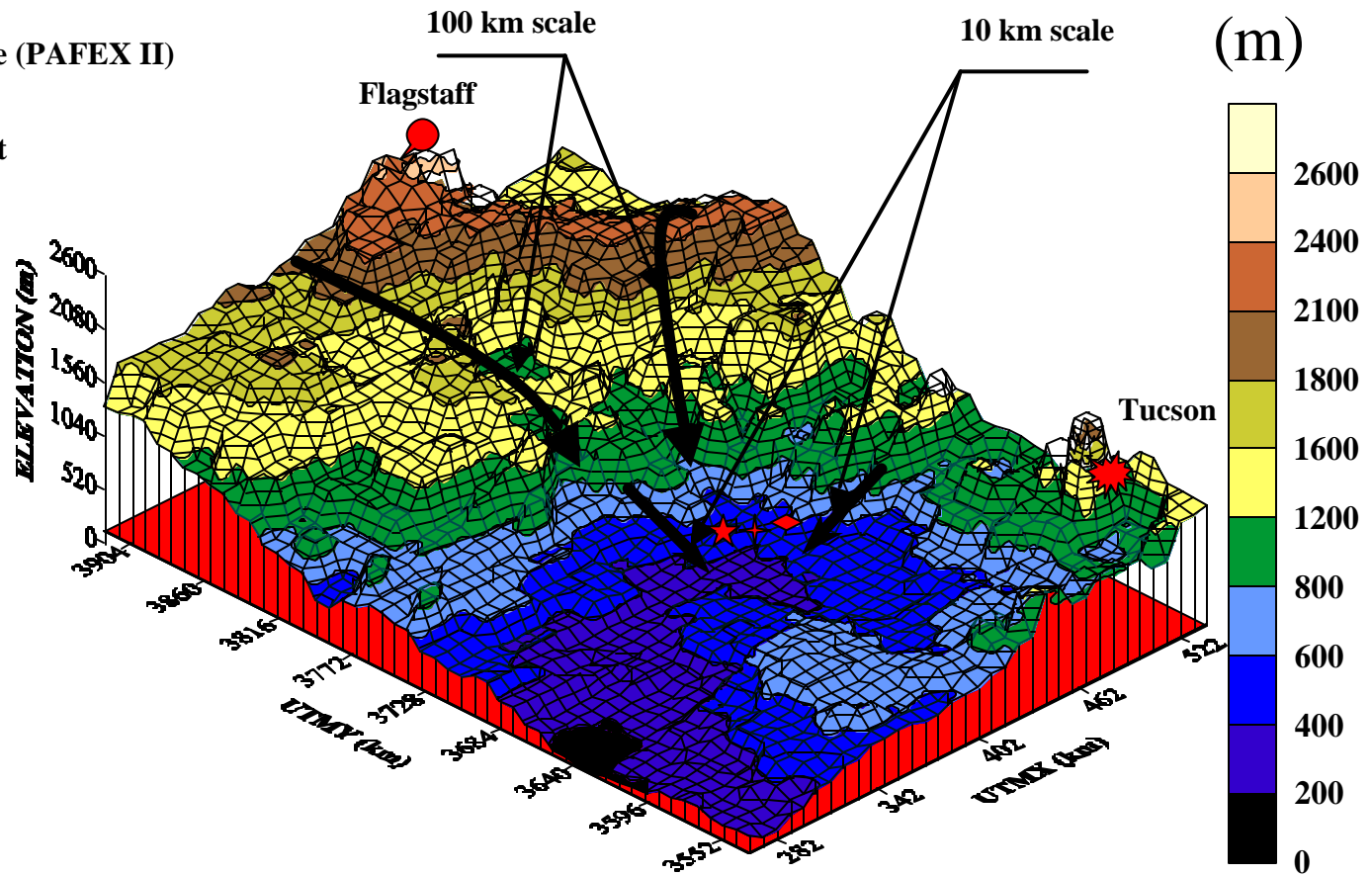
Summer Experiment:

Ozone, Nitrogen oxides and particulates (Advective conditions)

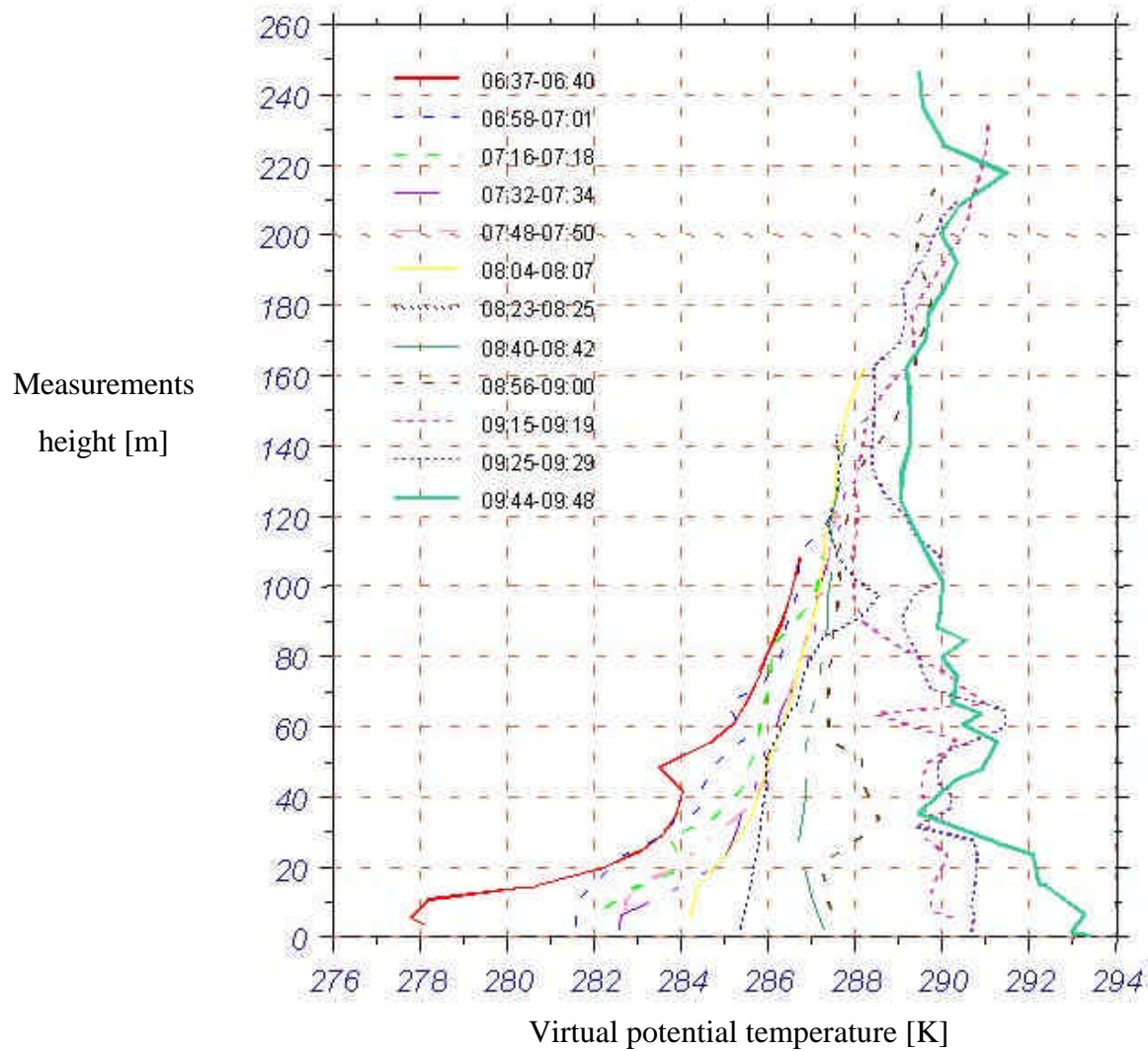
- Tethered balloon
- Ground meteorological station
- Sonic Anemometer (turbulence)
- Particulates using a streaker
- Ozone, NO_x, Noy and CO
- 44 meteorological stations run by public organizations
- Urban Airshed model, MM-5, HOTMAC and DWM

The terrain covering the bulk of populated cities in Arizona, including the Phoenix basin where two PAFEX experiments were performed

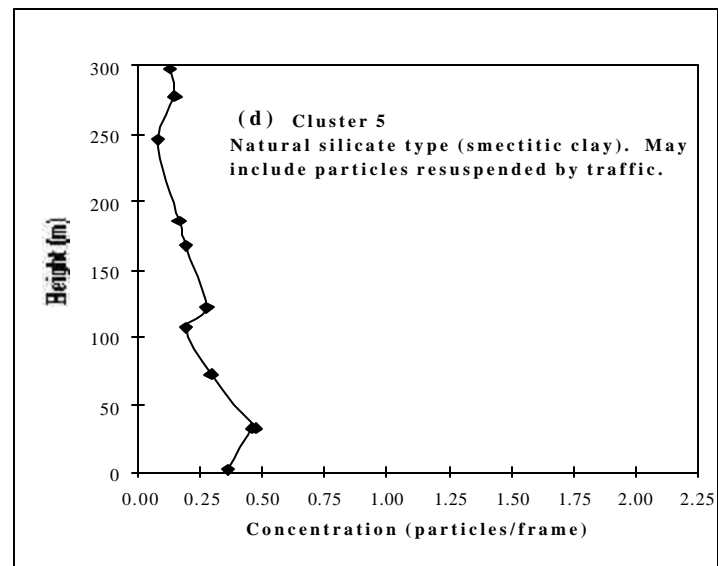
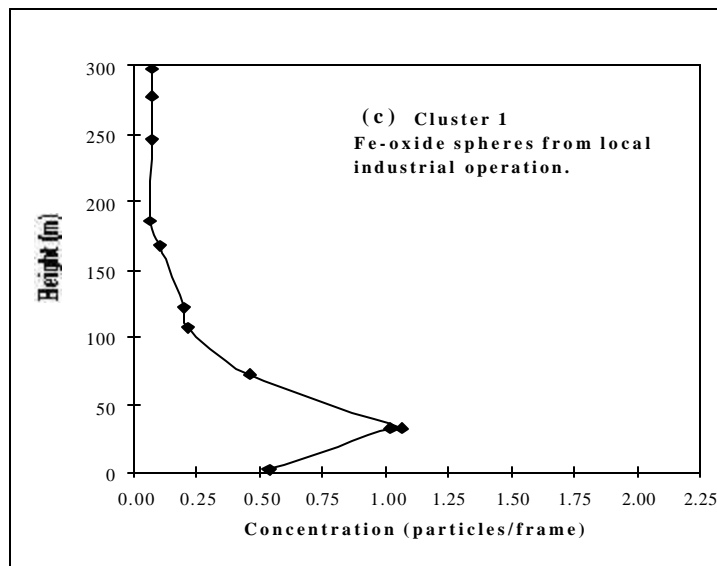
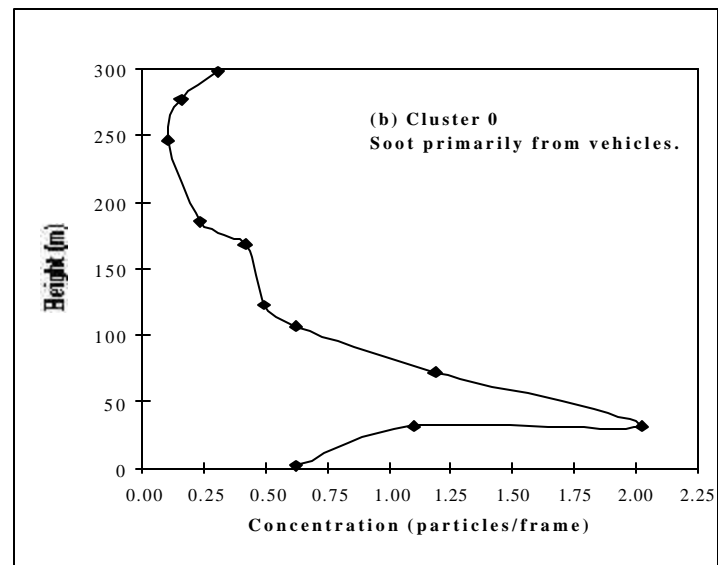
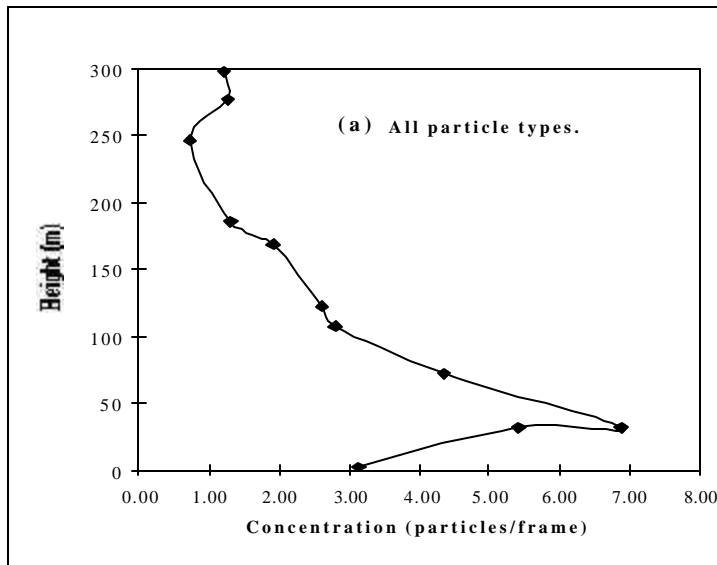
- ★ -Grand Canyon Site (PAFEX I)
- ◆ - Falcon Field Site (PAFEX II)
- ✦ -Phoenix Airport



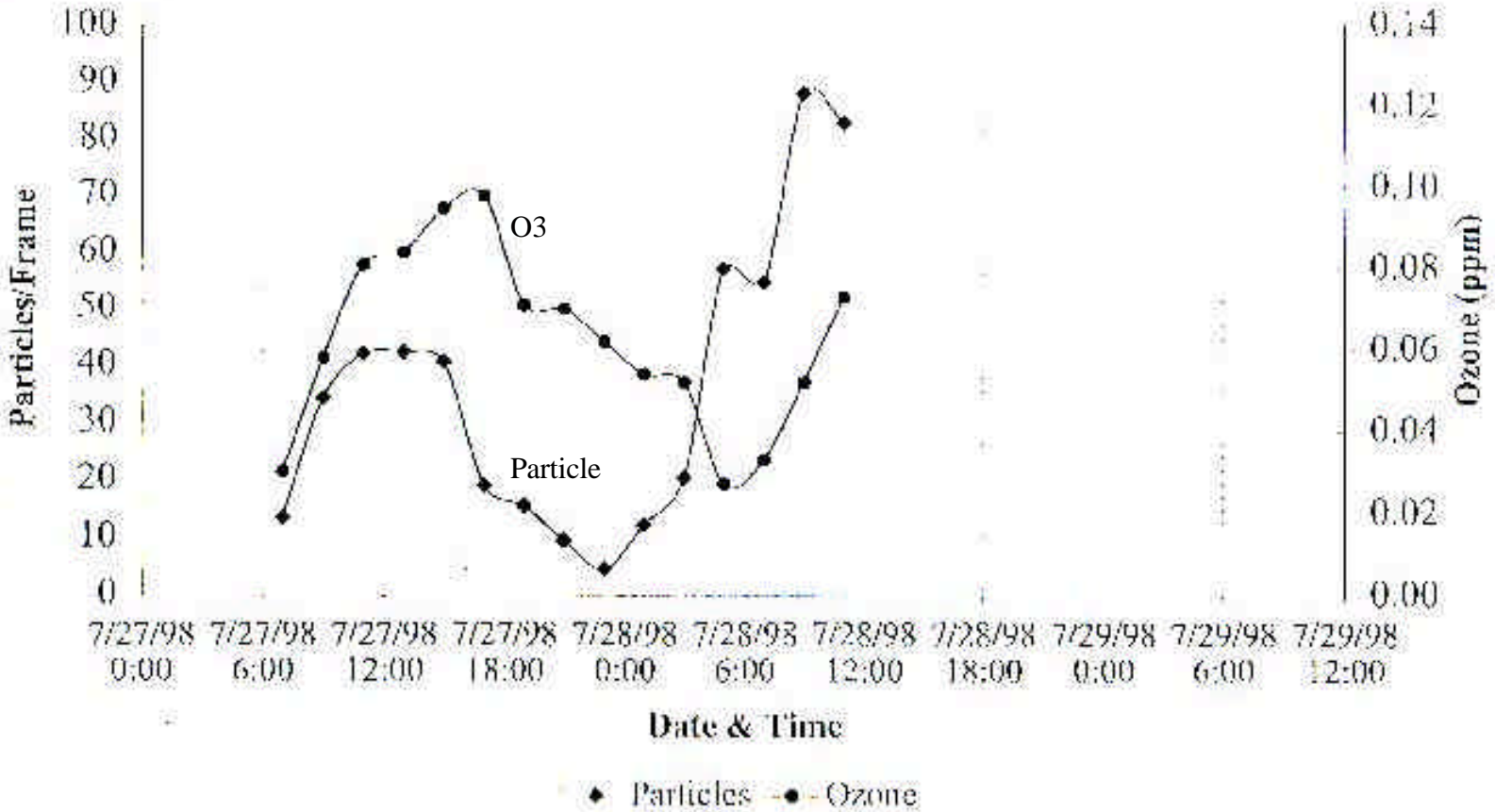
Morning Evolution of the Virtual Potential Temperature PAFEX-I, February 01, 1998, sonde 7L0364, upward profiles




Phoenix, Arizona – 23 January 1998 AM
Particles 0.1 to 10 μm , 15 minute samples

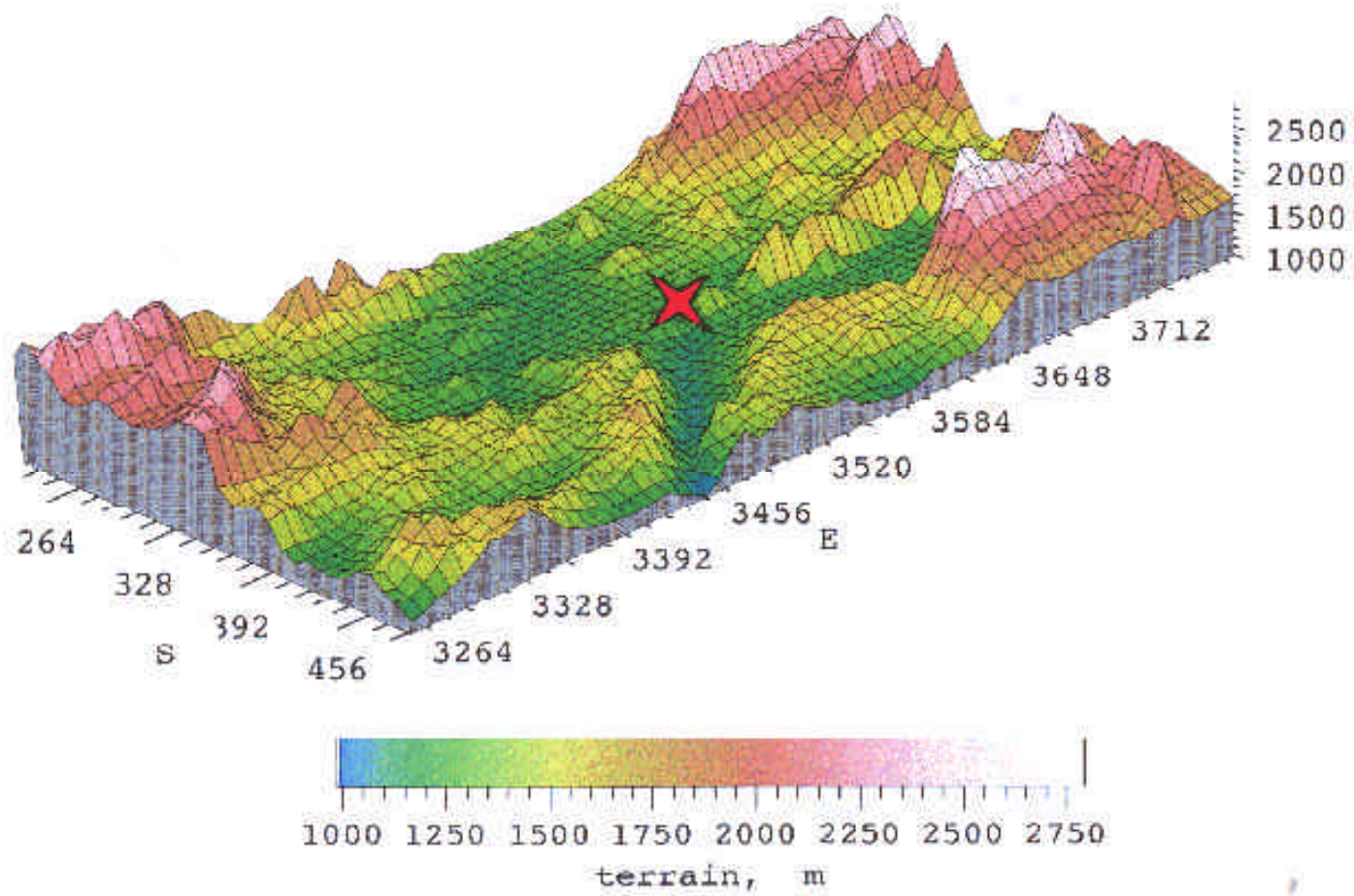


27–28 July 1998 (Days 208-209)
Falcon Field
Particle (2-hr) & Ozone (1-hr) Concentrations

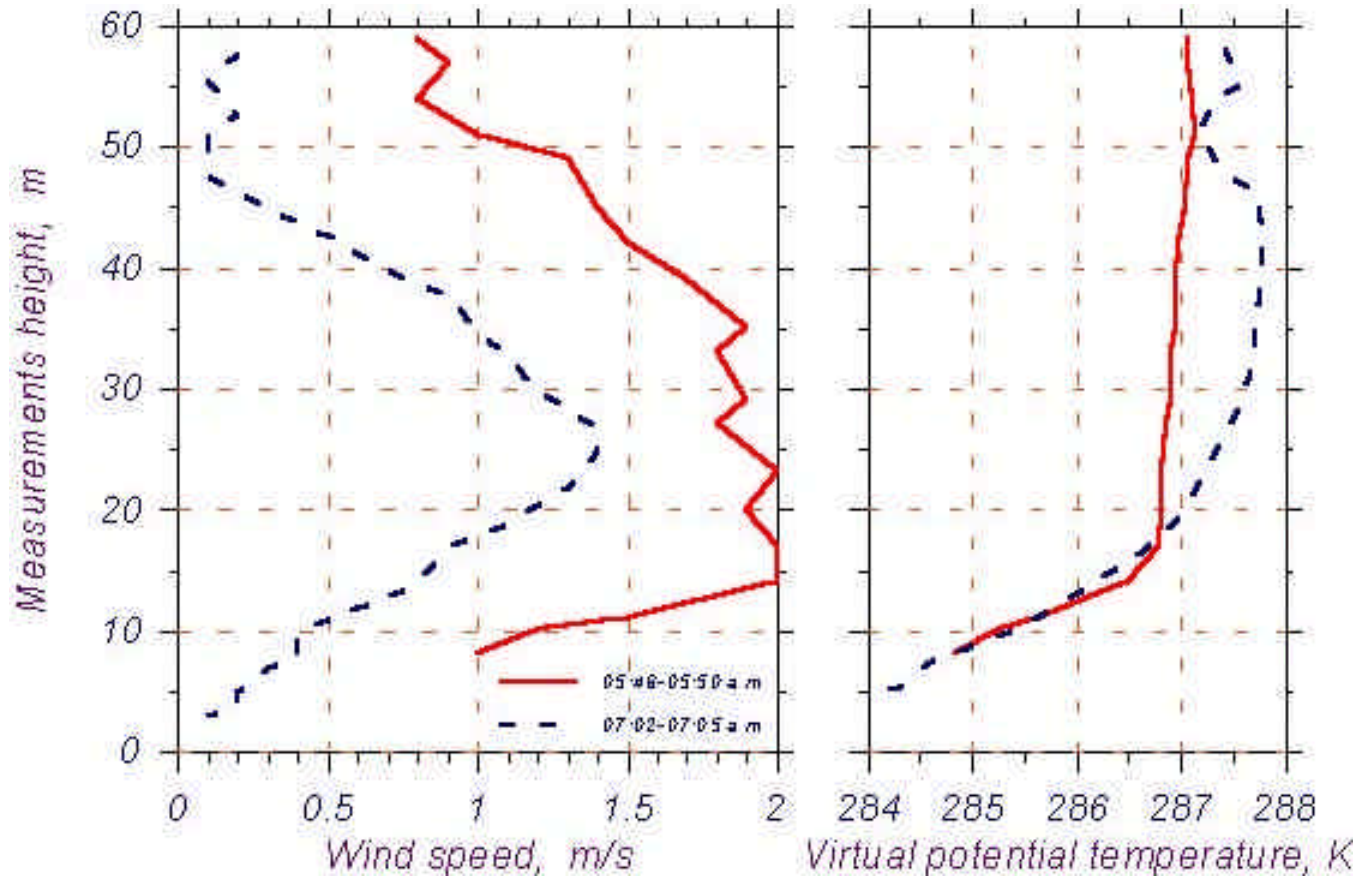


El Paso area terrain – 8 km grid spacing

 -- El Paso downtown



Velocity and virtual potential temperature profiles through the jet observed at 5:48 – 5:50 and 7:02 – 7:05 a.m. January 22, 1998.



Humidity

comparisons of numerical with experimental results
on 18:00 pm, Aug. 11, 1996

