The Meteor Crater Experiment

METCRAKX 2006

An Upcoming Study of Boundary Layer Evolution and Seiches in Arizona’s Meteor Crater
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T-REX TERRORIZES TRAILER PARK

60 MILLION-YEAR-OLD KILLER IS ON THE LOOSE!

PLUS THE MOST FRIGHTENING GHOSTS – EVER!
METCRAK overview

- 3 year meteorological research program supported by NSF grants to the 4 PIs and through field support from NCAR
- Field phase: October 2006 -- Continuous measurements during month + ~8 intensive observational periods (IOPs) in which tethersondes and rawinsondes will be flown
- Numerical modeling and analysis (mesoscale numerical model, LES, DNS)
METCRAKX Objectives

- Investigate the diurnal buildup and breakdown of basin temperature inversions or cold air pools and the associated physical and dynamical processes.
- Determine the role that basin-scale seiches and internal waves play in transport and mixing in basin stable layers.
Motivation

- Physical processes leading to boundary layer evolution are poorly understood in complex terrain.
- This has led to forecasting problems.
- Improved understanding of the basic physics may lead to better forecasts.
- Understanding of physics may be easier in simple laboratory-like conditions.
Basins and air pollution

Austria’s Klagenfurt basin

Helmut Ditsch drawing

Salt Lake Basin, Utah

Vail, Colorado
Stratus

Salt Lake Valley from Alta, Jan 2004

Craig Clements photo

Axel Hennig photo
Well-formed basins

Gruenloch Basin

near Mauna Loa, Hawaii

Meteor Crater, AZ

Kennecott copper mine nr SLC, UT

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Nature Conservancy photo
Uniform rim height
On a flat plain
No large-scale advection
The “right” size
The crater

165 m depth

1.2 km diameter
Cold Pool Buildup/Breakup

- Determine physical processes that govern boundary layer evolution
  - Slope flows
  - Radiative transfer (long- and short-wave)
  - Turbulent transfer
  - Asymmetries in bl structure and evolution
  - Ambient flows above basin
Preliminary measurements - Temperature Inversions

![Graph showing temperature inversions over time]

- **Daily max** temperatures vary significantly over the months.
- **Daily min** temperatures are relatively stable compared to daily maxes.

*Graph data spans from October 2005 to July 2006.*
Seiches/Gravity Waves

- Seiches: “standing waves in enclosed or partially enclosed bodies of water” have been observed in lake basins, reservoirs, bays, etc.

- Basin cold pools may exhibit oscillations similar to a basin of water. These resonant modes might occur in a basin disturbed by wind or atmospheric pressure oscillations.
NCAR field support:
Dr. Tom Horst, ISFF
Dr. Bill Brown, ISS

Equipment transport:
Airwest Helicopters, Glendale, AZ

Site permissions:
Barringer Crater Co. 
Meteor Crater Enterprises

Tethered balloon sounding system
Inside the crater

- **Continuous observations:**
  - Two lines of HOBOs
  - 7 ISFF towers
- **IOP operations:**
  - 3 tethersondes make occasional up-down soundings to 500 ft above crater rim from ~3 pm to ~10 am

Outside the crater

- **Continuous observations:**
  - Radar profiler/RASS and Doppler sodar/RASS
- **IOP operations:**
  - Rawinsondes at 3-h intervals
Installing Instrumentation

Installing HOBOs

Helicopter Operation

Inside the Crater
Conclusions

- METCRAX, October 2006
- Boundary layer structure evolution
- Seiches
- Results to be presented at next Mountain Meteorology Conference