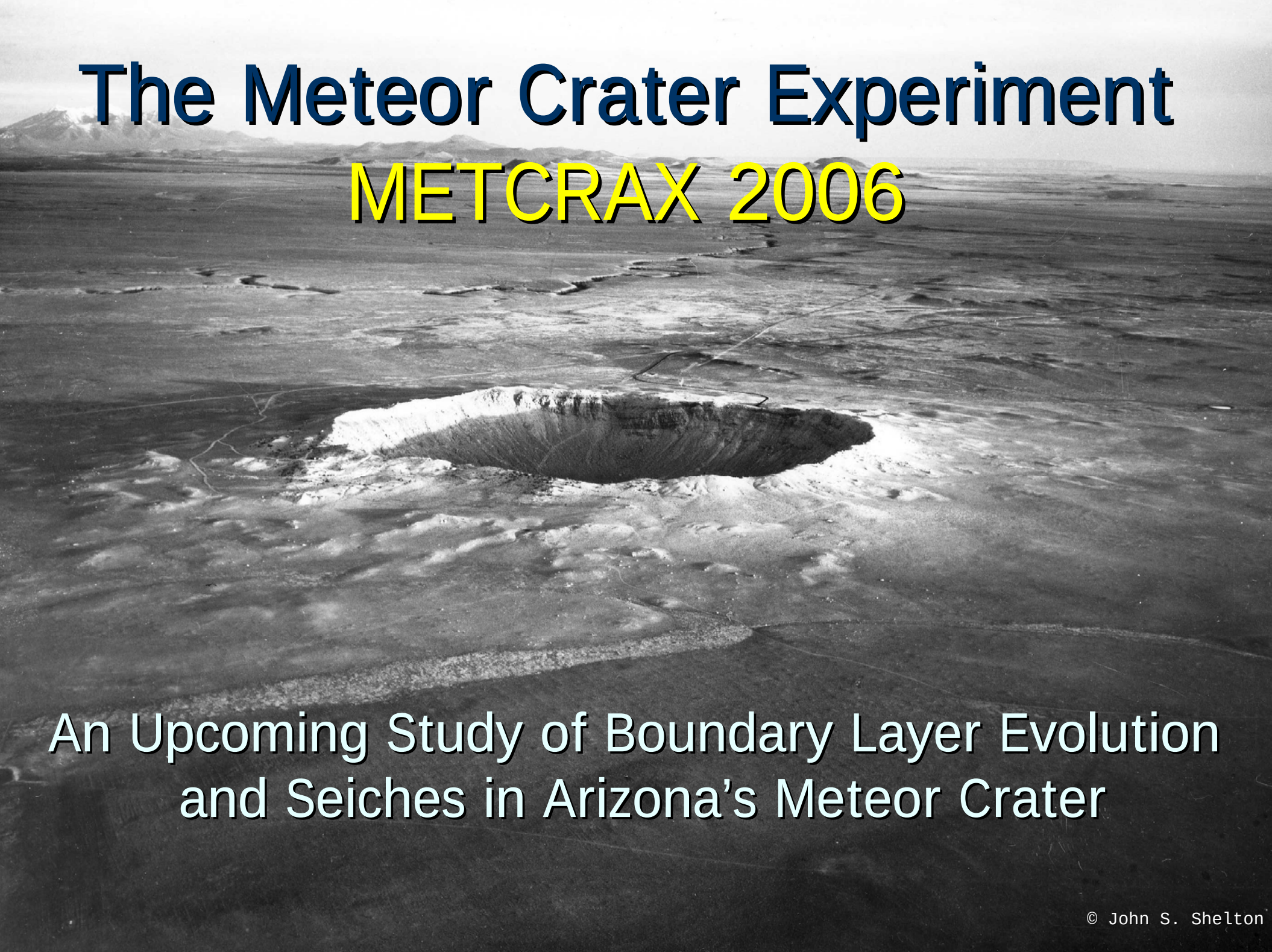
The Meteor Crater Experiment

METCRAX 2006



An Upcoming Study of Boundary Layer Evolution and Seiches in Arizona's Meteor Crater

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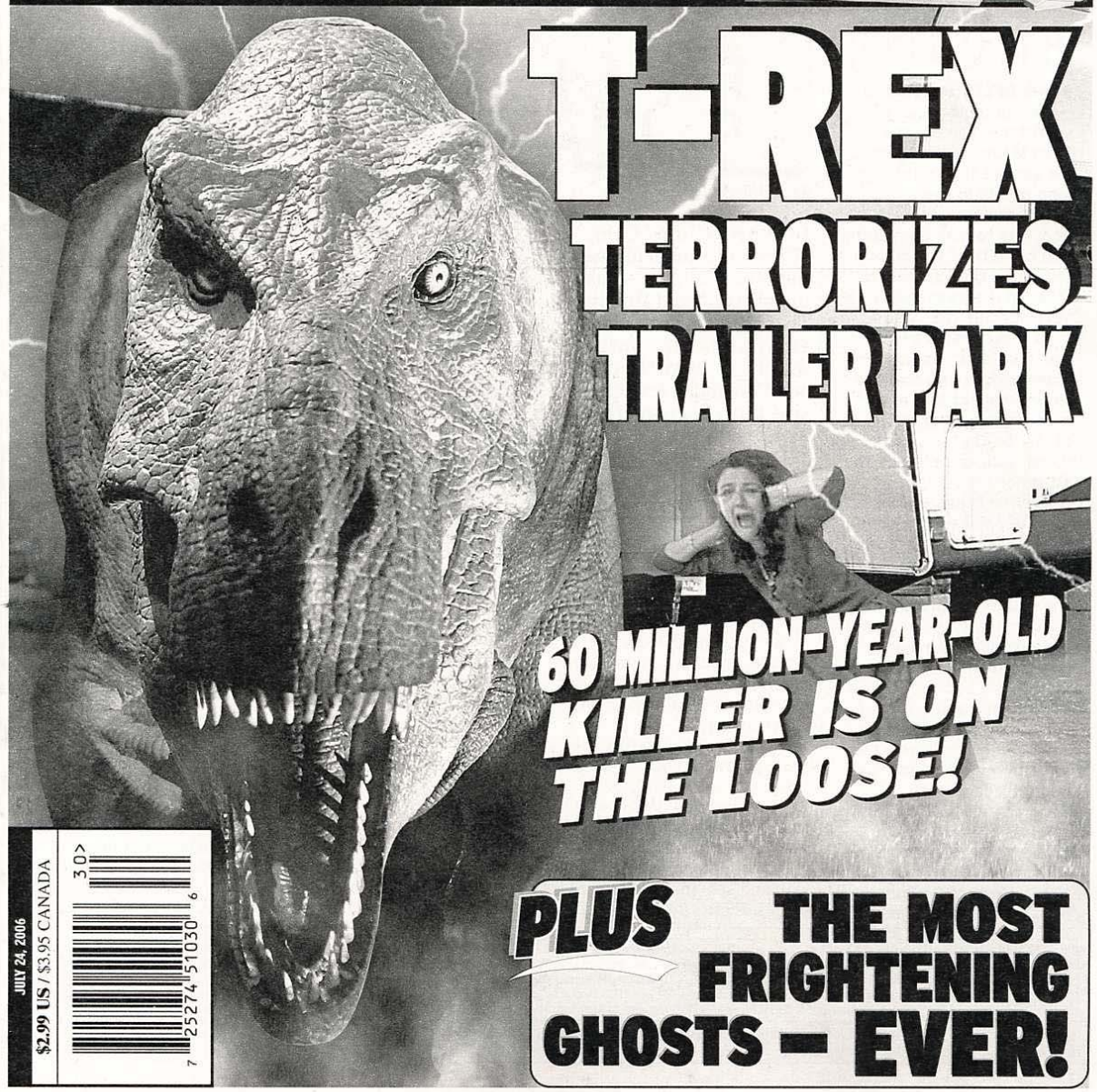

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METCRAX overview

- 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)

METCRAX 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

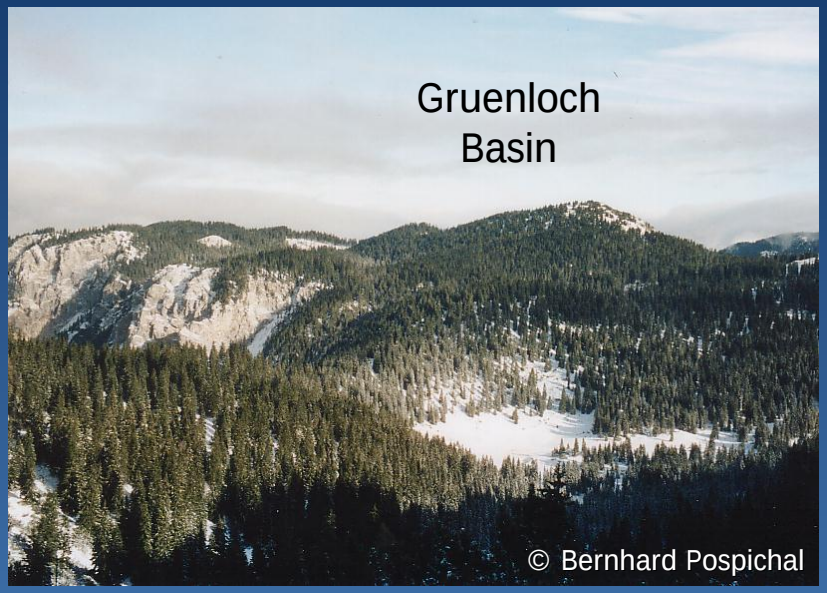
Stratus

Salt Lake Valley from Alta, Jan 2004

Craig Clements photo

Axel Hennig photo

Well-formed basins

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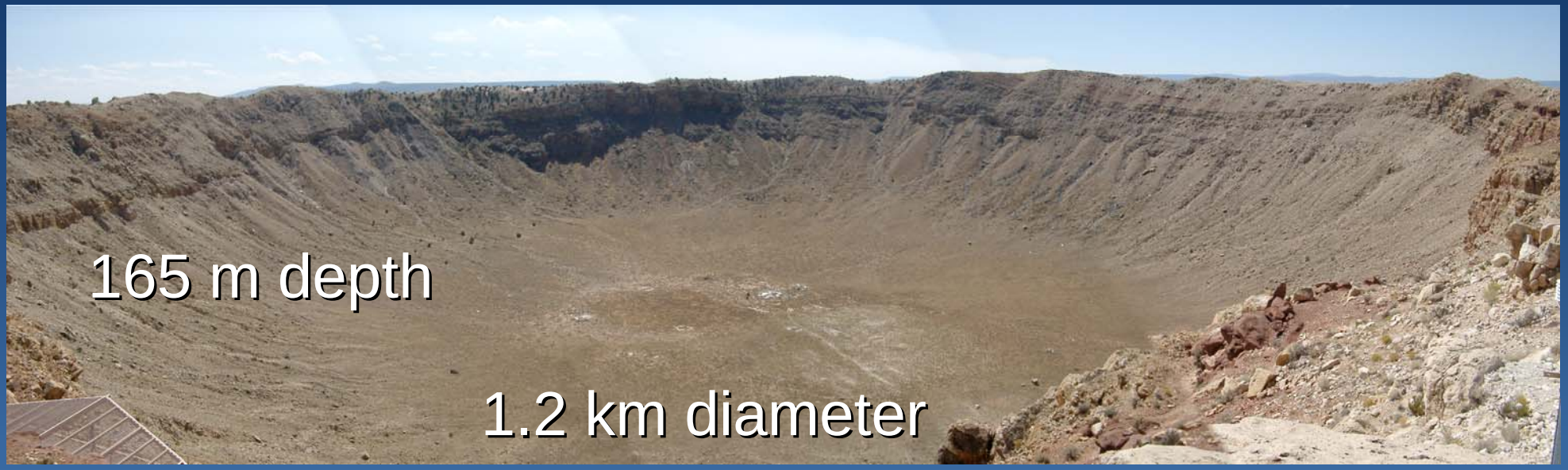
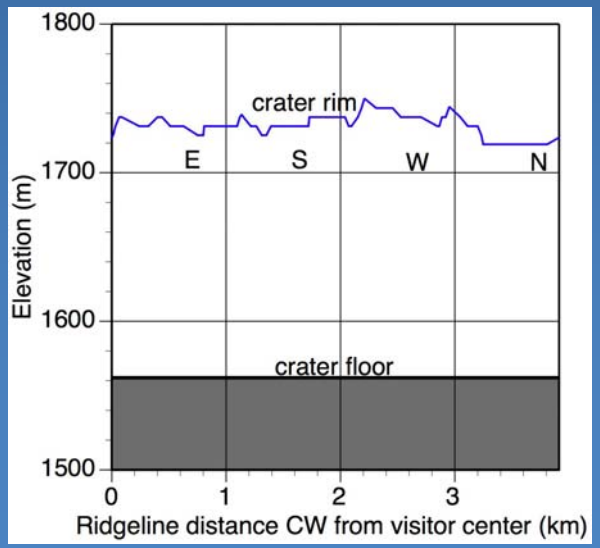
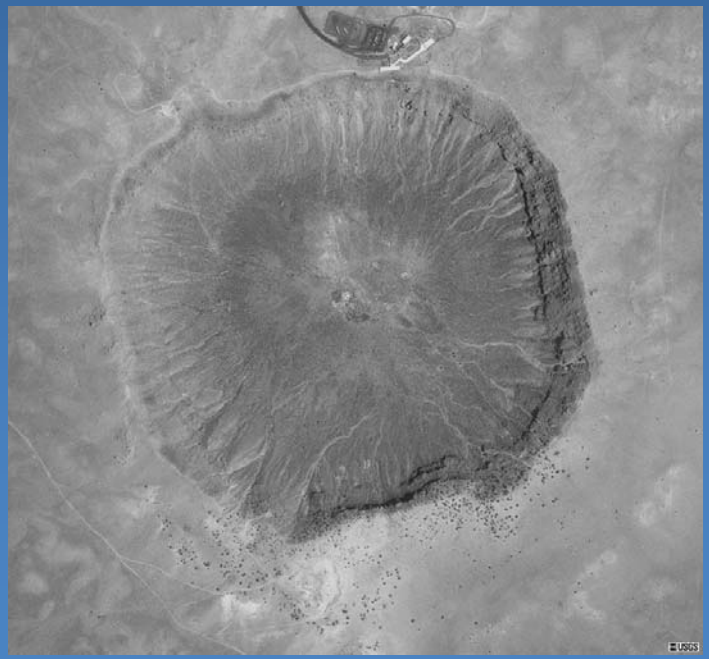
Uniform rim height
On a flat plain
No large-scale advection
The “right” size
© John S. Shelton

The crater


165 m depth
1.2 km diameter

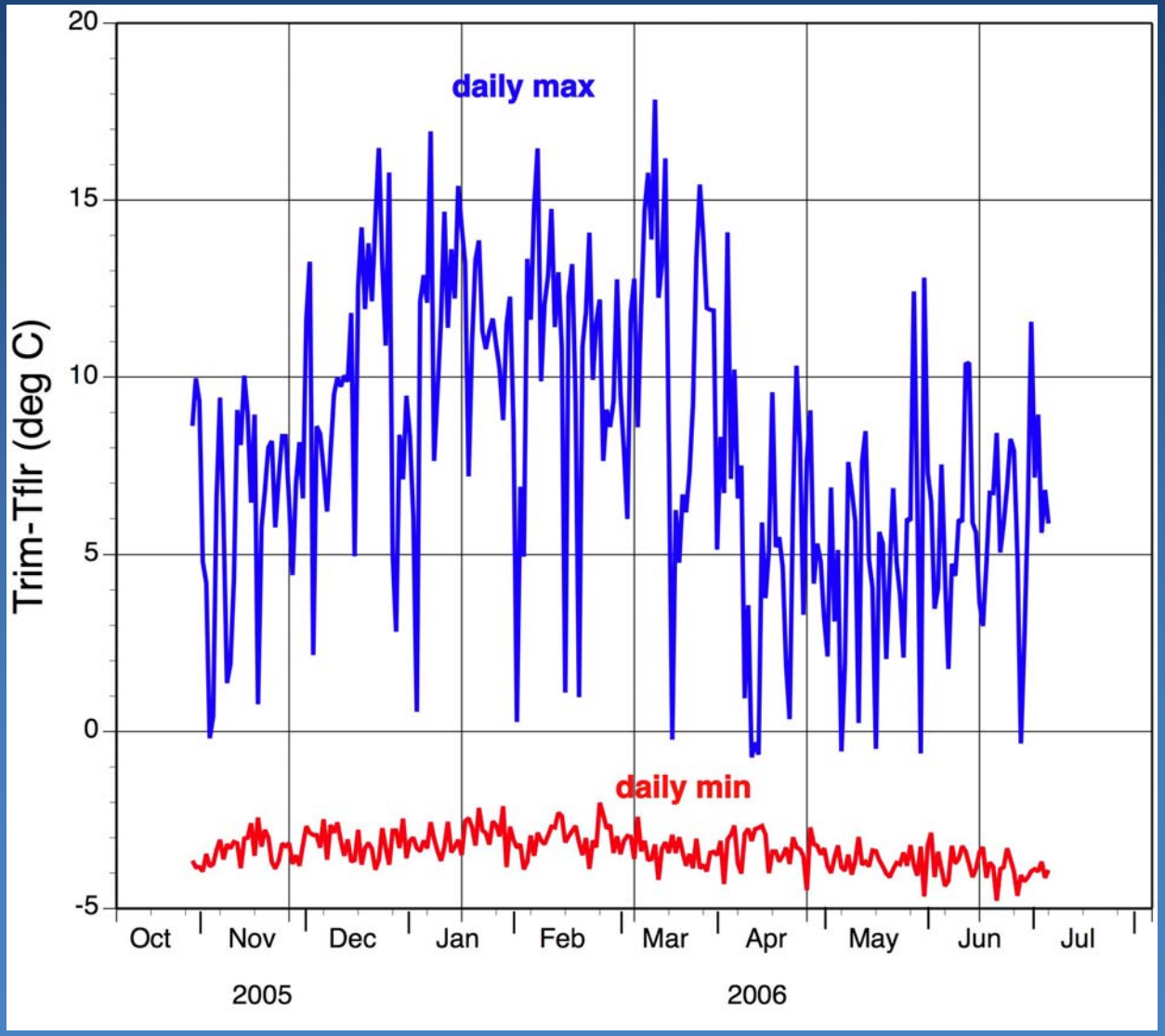

1800
1700
1600
1500
crater rim
E
S
W
N
crater floor
Elevation (m)
0
1
2
3
Ridgeline distance CW from visitor center (km)



Cold Pool Buildup/Breakup

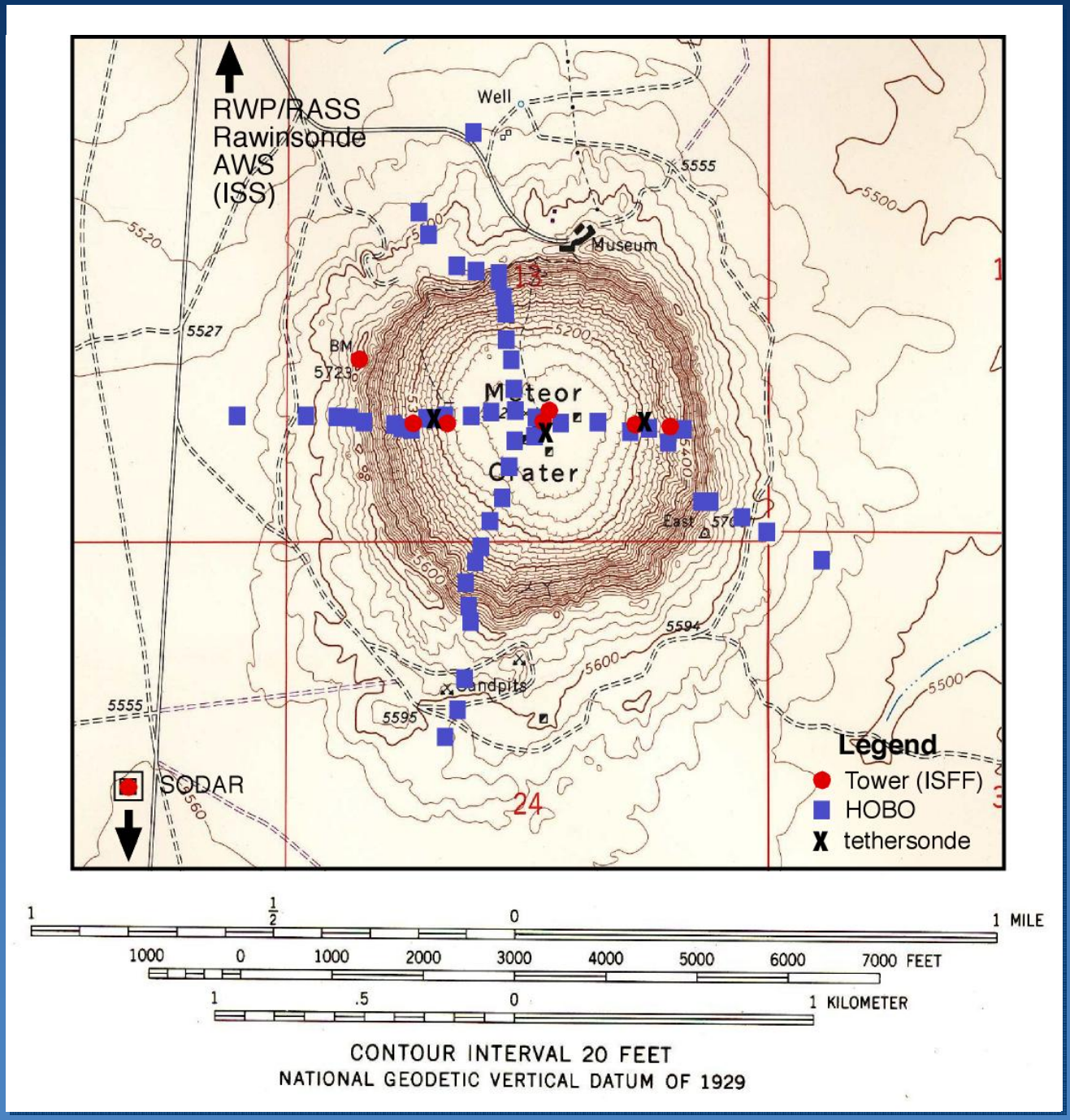
- Determine physical processes that govern boundary layer evolution
  - Slope flows
  - Radiative transfer (long- and short-wave)
  - Turbulent transfer
  - Asymmetries in bl structure and evolution
  - Ambient flows above basin

Preliminary measurements - Temperature Inversions



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:

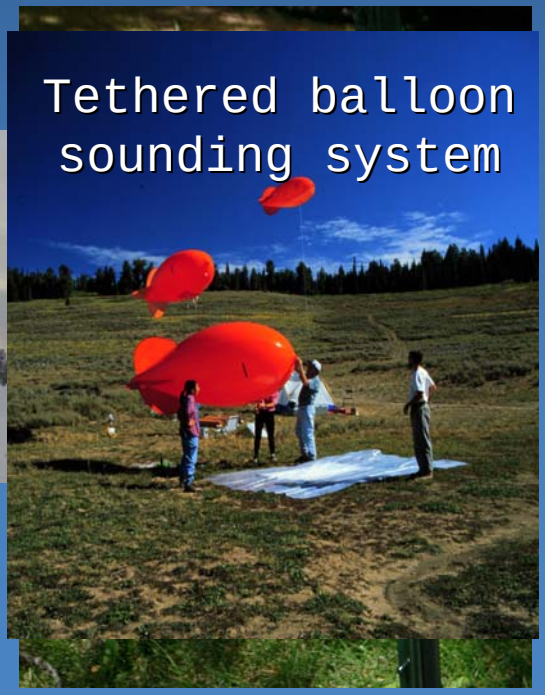
Dr. Tom Horst, ISFF
Dr. Bill Brown, ISS

Equipment transport:

Airwest Helicopters, Glendale, AZ

Site permissions:

Barringer Crater Co.
Meteor Crater Enterprises



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