Overview of the Persistent Cold-Air Pool Study (PCAPS) Field Program

Dave Whiteman, John Horel, Erik Crosman, Neil Lareau, Sebastian Hoch and Joe Young

University of Utah
Types of CAPs

Cloudy

Craig Clements photo

Dry

Jim Steenburgh photo

Heterogeneous

Erik Crosman photo
Motivation

• Persistent wintertime inversions or cold-air pools form in all mountain areas
• In urban valleys and basins, the pools produce strong impacts on:
  – air pollution and human health, quality of life
  – air and ground transportation
  – forecasting

PCAPS Goals

• Identify meteorological processes leading to development, maintenance, and breakup of persistent inversions.
• Determine how meteorological models can be improved to provide more accurate simulations of persistent inversions.
Salt Lake Basin
Field Program: 1 Dec 2010 – 7 Feb 2011

• Objectives of field program in Salt Lake Valley
  – Document cold pool processes ranging from the ground up to the mid-troposphere and from microscale to synoptic scale
  – Document 3D nature of CAPs in unprecedented detail

• Measurement Strategy
  – Continuous automated measurements
  – Intensive Observing Periods (IOPs) during inversion events
  – Special sub-IOPs
    • Lake boundary Layer
    • Southerly mix-out events
    • Wasatch tributaries
Wind Profiler and Sounding Sites

- 915 MHz Wind Profiler with RASS
- WXT Met Tower
- 449 MHz Wind Profiler
- Met. tower 10m winds
- Temp, RH, P
- Solar Radiation
- Sodar
- Microwave Radiometer
- Scanning lidar
- Web Cam
- Ceilometer
- HeLium
- Sounding
- PCAPS

B. Brown photo
Soundings
ISFS site

- Rain gauge
- Sonic anemometer
- Wind vane
- Temp, RH, P
- Solar panels
- Radiation sensors
- Soil parameters 1
- Soil parameters 2

S. Oncley photo
U of U Atmospheric Sciences

Mini-SODAR

ASC photo

Scanning wind Lidar

Mobile weather stations

Temperature dataloggers
Selected Impressions

- Cold-air pool is substantively influenced by synoptic interactions
- Isothermal profiles and multi-layer inversions with well-mixed layers in between are quite common
- Cloud cover and snow cover can have major impact on structure
  - Very light snow/rain have little effect
- Inhomogeneities are often present – sloshing and transport
- Forecasting fog/stratus formation/dissipation remains very difficult
WARM/COLD AIR ADVECTION

- Arrow indicating movement of warm/cold air over landscape.
- Markers at t=0 and t=1 showing time progression.

Diagram illustrates the process of atmospheric advection, showing how warm or cold air moves over a landscape with mountains and valleys.
SOUTHERLY WIND MIX OUT
PCAPS - NCAR CL31 Ceilometer with ISS Radiosondes 03 Jan 2011 0000 UTC - 04 Jan 2011 2100 UTC

- **Ceilometer/radiosondes – IOP 5**
- **Ridgeline**
- **Valley inversion**
- **Aerosol layer**

**Logarithm of lidar backscatter** ($m^{-1}sr^{-1}$)
Future Research

• Evaluate hypotheses and mechanisms by analyzing appropriate IOPs

• Modeling
  – Evaluate operational guidance
  – Perform research simulations – LES to mesoscale

• How to generalize to other basins
Field Study Participants

• NCAR Earth Observing Laboratory (led by Bill Brown and Tom Horst)
• 50 UU colleagues/students (Dave Bowling, Eric Pardyjak, Geoff Silcox, Court Strong,)
• San Jose State University (Craig Clements)
• San Francisco State University (Andrew Oliphant)
• Utah DAQ & DOT
• NOAA/NWS SLC Forecast Office