Dugway Proving Ground Perspectives on the MATERHORN Field Campaigns

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Meteorology Division
Dugway Proving Ground

An ATEC operated proving ground with installation operations managed by IMCOM.

MATERHORN project

MOUNTAIN TERRAIN ATMOSPHERIC MODELING AND OBSERVATIONS (MATERHORN)

Collaboration of universities and government

Two large field tests utilizing the Granite Mountain Atmospheric Sciences Testbed (GMAST) facility (discussed separately at this workshop)

Designed to identify and study the limitations of current mesoscale models for mountain terrain weather prediction and develop tools to improve predictability

Project components:

- Modeling Component (MATERHORN-M)
- Technology Component (MATERHORN-T)
- Parameterization Component (MATERHORN-P)
- Field Experiment Component (MATERHORN-X)

Project team

Principal Investigators:

H.J.S. Fernando
(University of Notre Dame)

Eric Pardyjak
(University of Utah)

Stephan De Wekker
(University of Virginia)

Josh Hacker
(NPS/NCAR)

Tina Katopodes Chow
(Univ. California, Berkeley)

Partners:

Dugway Proving Ground
Navy Research Laboratory
Army Research Laboratory
University of London
Tel Aviv University

Collaborators:

NCAR , NOAA , Princeton University
Oregon State University
University of Colorado
IIBR, Israel
University of Bergen, Norway
University of Vienna, Austria
École Polytechnique De Montreal, Canada
University of Lecce, Italy

MATERHORN-X (Field Trials)

The scientific objective of MATERHORN-X is a comprehensive study of the interaction of small and large-scale motions in complex terrain

Support the efforts to improve flow predictability via understanding of model errors, error growth and predictability limits

The collected data will facilitate model validation, data assimilation and development of physics-based parameterizations

MATERHORN-X trials:

- 1 - 31 October 2012: MATERHORN-X-FALL (DPG)
- 1 - 30 May 2013: MATERHORN-X-SPRING (DPG)
- TBD: MATERHORN-X-Fog (Heber Valley & SLC, UT)

DPG support to MATERHORN-X

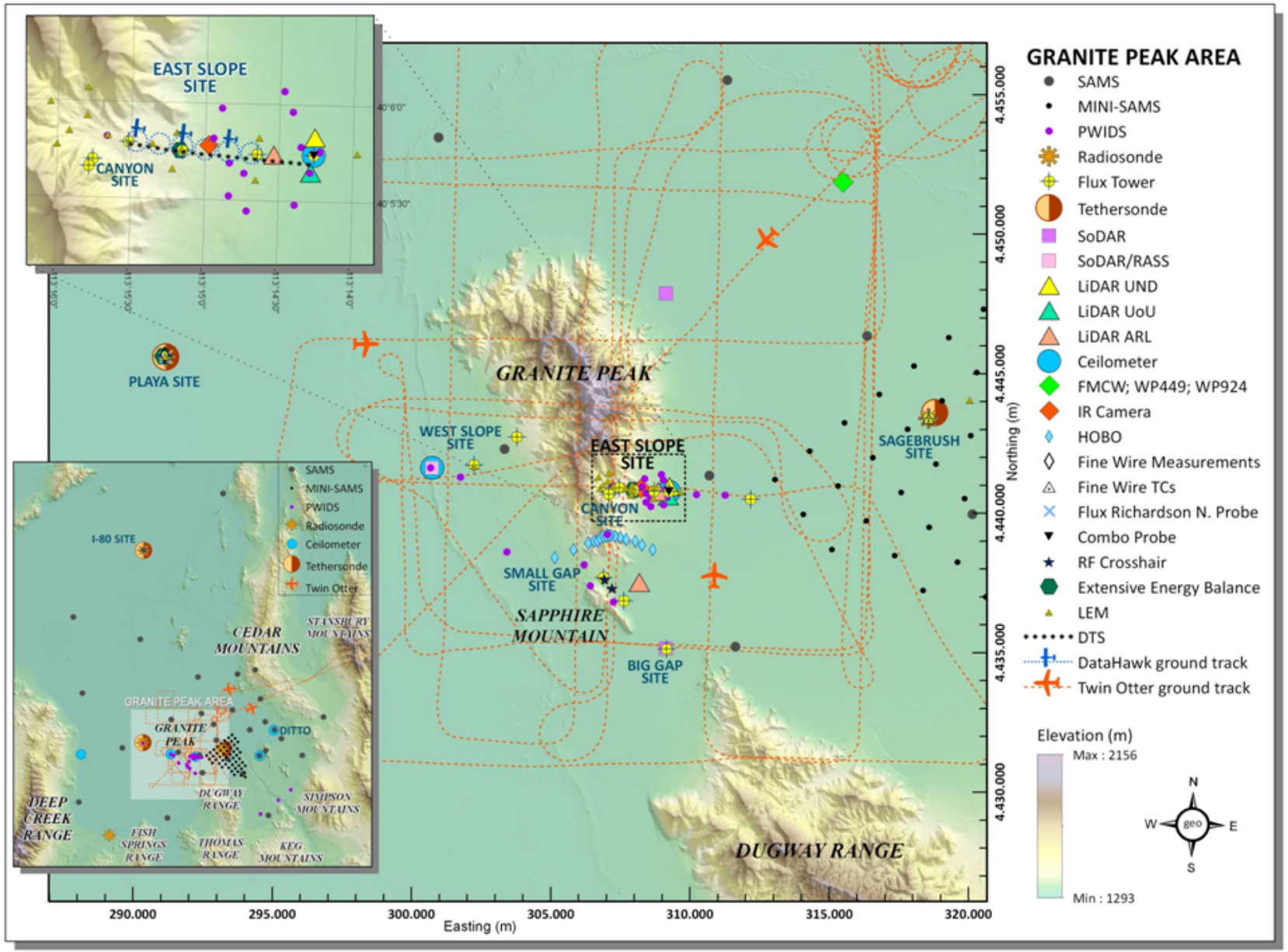
Weather forecast
- planning of IOPs
- weather warnings

Technical support
- tower setup
- dataloggers
- instrumentation/towers
- routinely collected data

Range Support
- generator maintenance
- tower maintenance
- safety/security

Test management
- scheduling
- DPG access
- logistics

Instrumentation – Fall 2012 campaign



Airborne measurements

Balloons

Twin Otter

Flamingo

DataHawk

Research progress

Data collection and management:

- 20 Intensive Operational Periods IOPs (24-36 hrs)
- 5 Intensive Operational Locations IOLs
- 55 TB Data – UND server

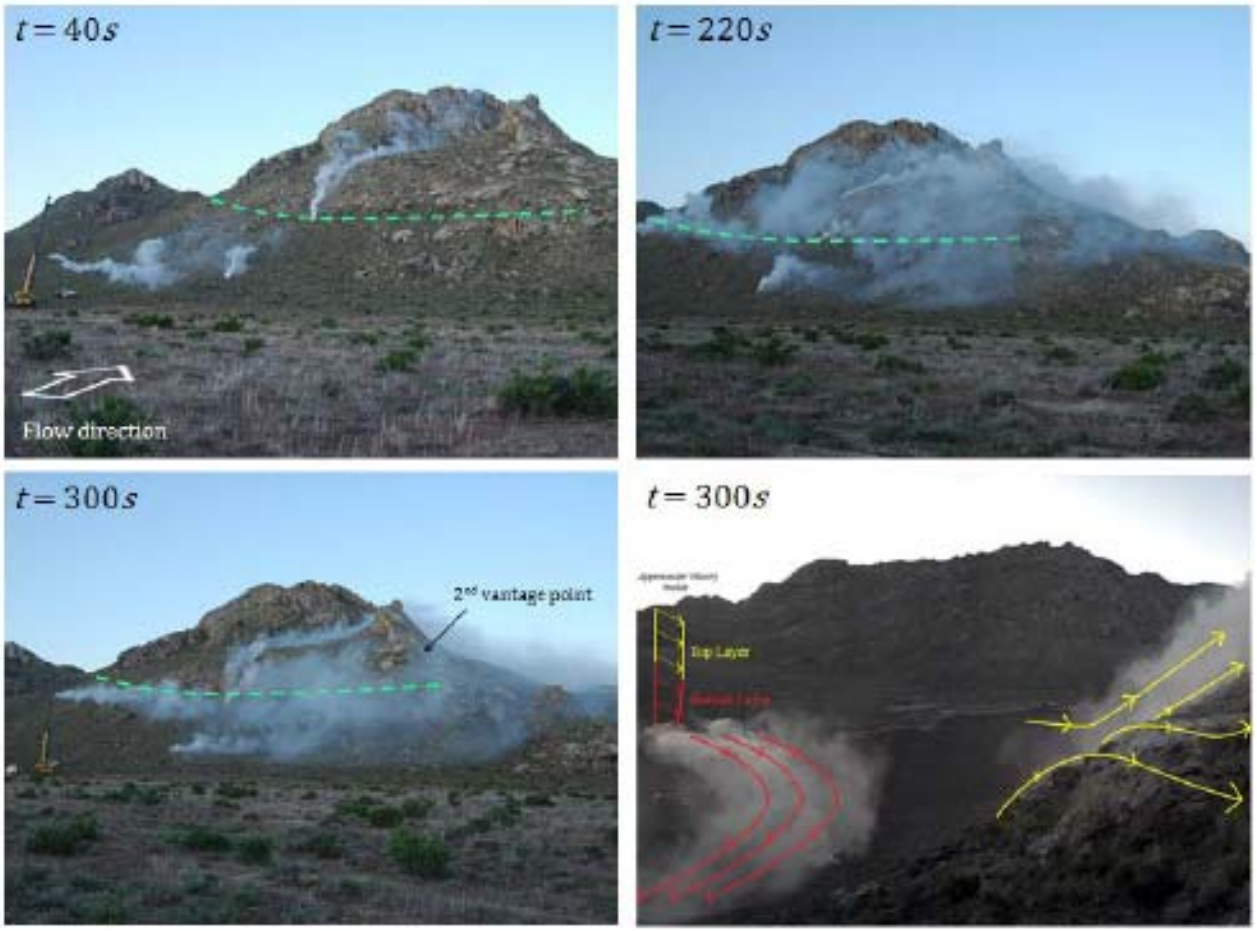
Preliminary results were presented at various meetings (AGU, AMS)

Bulletin of American Meteorological Society review paper was submitted

Special journal issues:

- Boundary-Layer Meteorology
- Environmental Fluid Mechanics
- AMS MATERHORN Special Issue

Dividing streamline concept



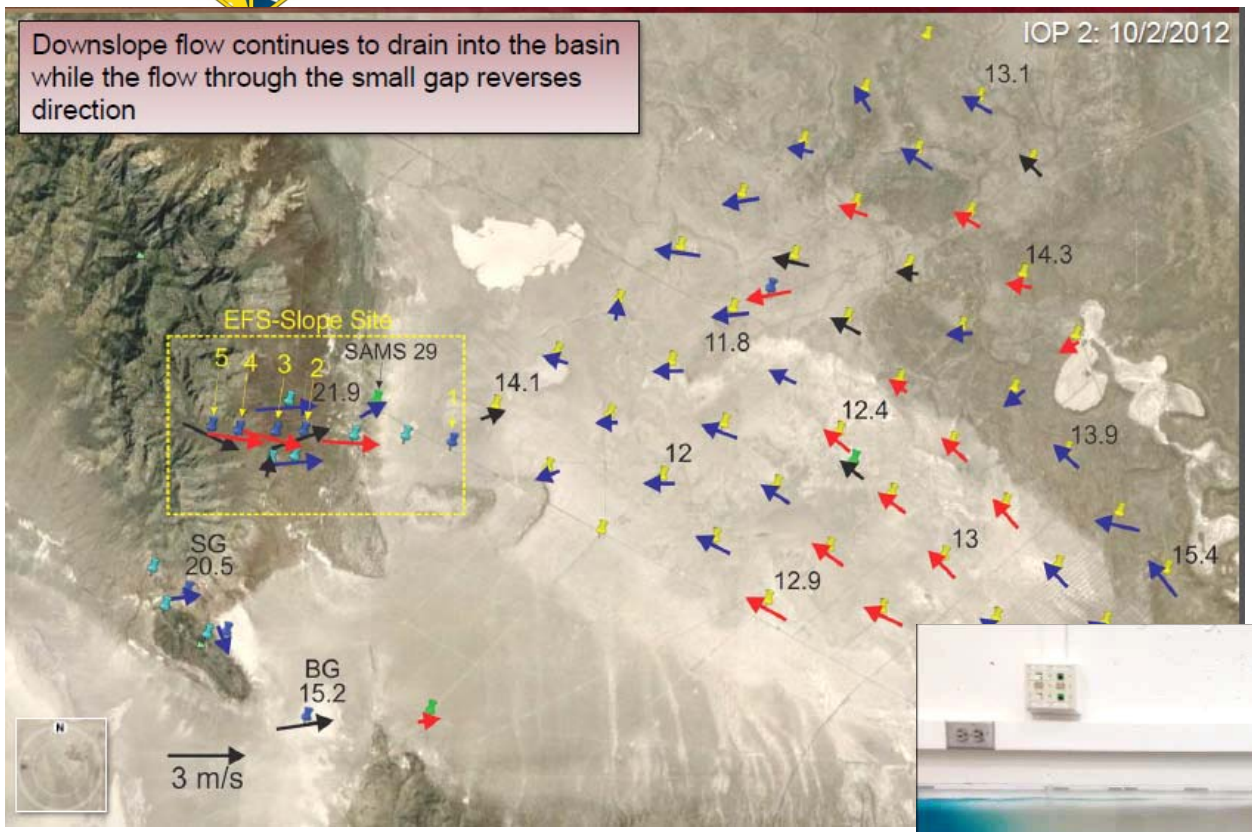
Study dividing streamline in stratified flow

Flow visualization using smoke

Thompson et al 2014 AMS meeting

University of Notre Dame team

Slope and valley interactions

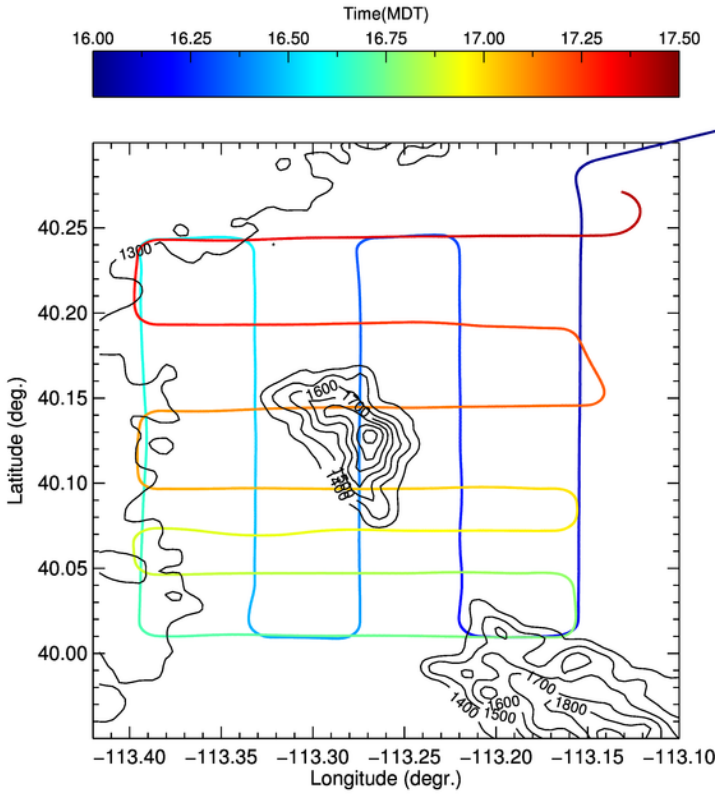


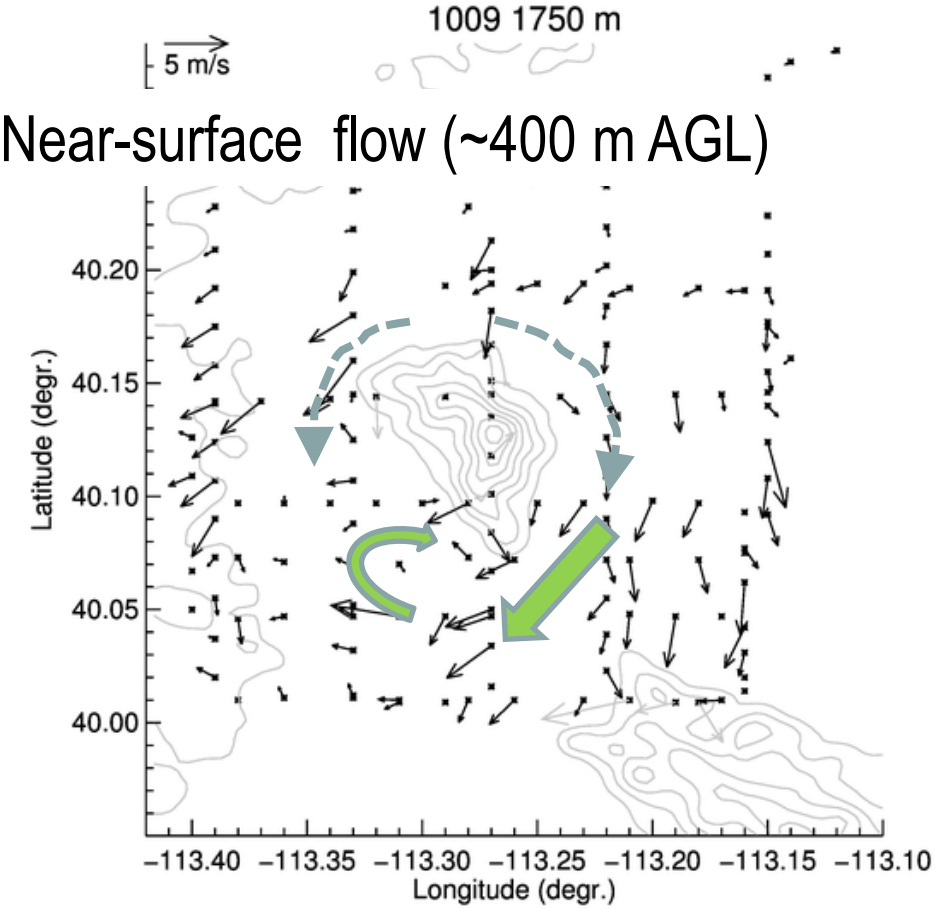
Combination of field testing with laboratory studies of:

collision of gravity currents, formation of intense turbulent regions, intrusions and instabilities

Hocut et al 2014, AMS meeting
University of Notre Dame and
Army Research Lab teams

Twin Otter flights (lidar)





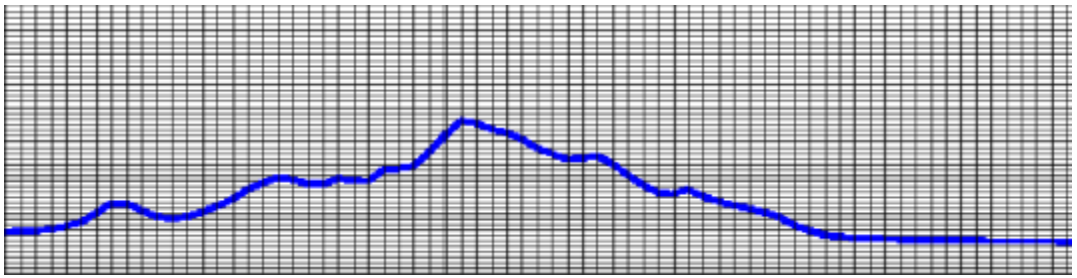
Example Flight and Wind pattern 9 October 2012

DeWekker et al 2013, AGU meeting 2013

University of Virginia, NCAR & Simpson Weather Assoc.

Modeling efforts

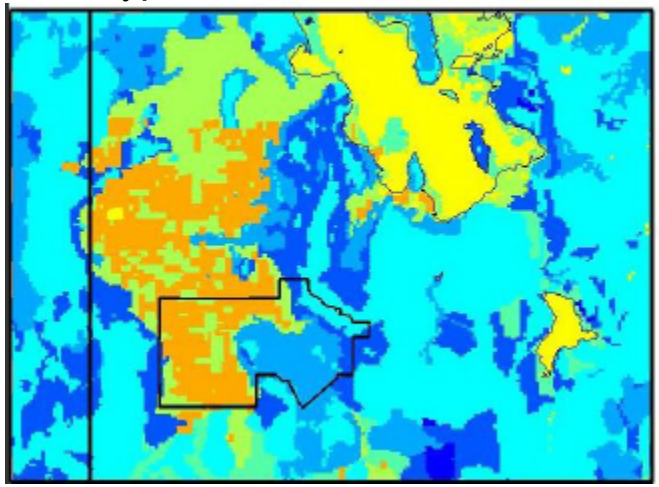
An immersed boundary method in WRF
for complex mountainous terrain



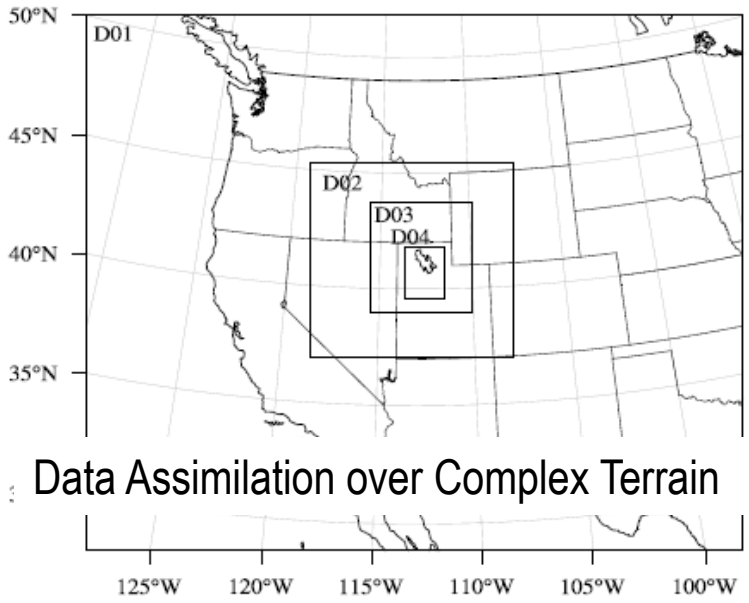
Chow et al 2013, AGU meeting
UC Berkeley & LLNL

Sensitivity of Near-Surface Temperature
Forecast to Soil Properties

Soil types over DPG



Massey et al 2013, AGU meeting
University of Utah & NCAR



Data Assimilation over Complex Terrain

Pu et al 2013, AMS meeting
University of Utah

Benefits and Challenges of Meteorological R&D at Dugway Proving Ground

Challenges/Solutions

- Far from airport, restaurants, homes
- Other duties for technicians, forecasters
- Lower priority than some other activities (affected scheduling, range access)
- Controlled access (foreign nationals restrictions)
- Largely unimproved working areas (isolation, roads)
- Incomplete wireless coverage (and internet)
- Procedures for airfield and other flights
- Security issues (photography, manned flights)
- Rules/restrictions for Lidar operations
- Nature of MATERHORN test (multiple locations, land and air operations, no advance schedule, IOP length)

Benefits

- Protected working area
- Experienced DPG technicians and forecasters
- Large-scale infrastructure in place (GMAST, sensors, radios, computers)
- Air space generally available
- Frequency availability
- Range access nearly all the time
- Generally good wireless coverage for data transmission
- UAV operations
- Good radio communication
- Higher level balloon soundings