

Observations and simulations of the wind structure in the boundary layer around an isolated mountain during the MATERHORN field experiment

Stephan F.J. De Wekker¹, Y. Liu², J.C. Knievel²,
S. Pal¹, G. D. Emmitt³

1. University of Virginia, Charlottesville, VA, United States.

2. National Center for Atmospheric Research, Boulder, CO, United States.

3. Simpson Weather Associates, Charlottesville, VA, United States



AGU meeting, San Francisco
9 December 2013

MATERHORN FIELD SITE

Looking north

Granite Mountain

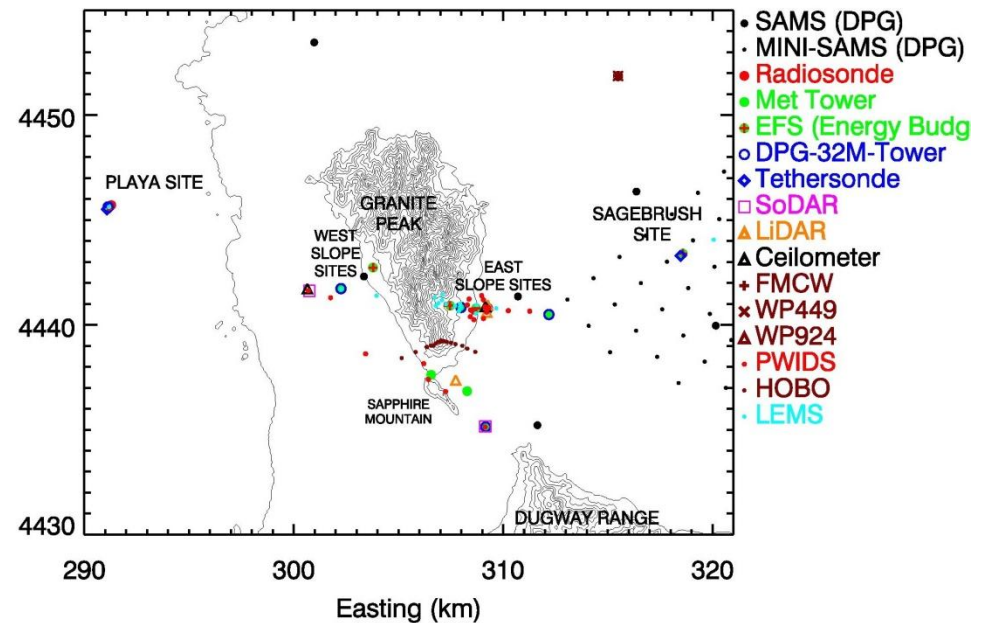
Sapphire Mountain

Looking south

Dugway Range

Sapphire Mountain

Granite Mountain



Twin Otter Doppler Wind Lidar



TODWL
SCANNER

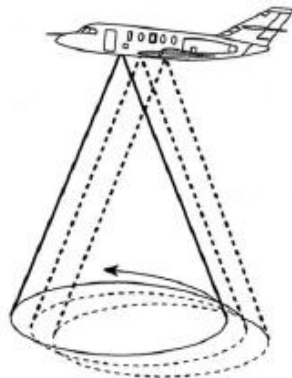
TODWL (Twin Otter Doppler Wind Lidar) has been operated since 2002 by CIRPAS (Center for Interdisciplinary Remotely Piloted Aircraft Studies), a part of the Naval Postgraduate School, Monterey, CA.

U,V,W with 50 m vertical resolution,
and 1.5 km horizontal resolution

**Accuracy: < 0.10 m/s in three wind
components**

SNR (aerosols)

2 μm coherent detector
side door mounted scan



conical scans below the aircraft
azimuth angle steps of 30°

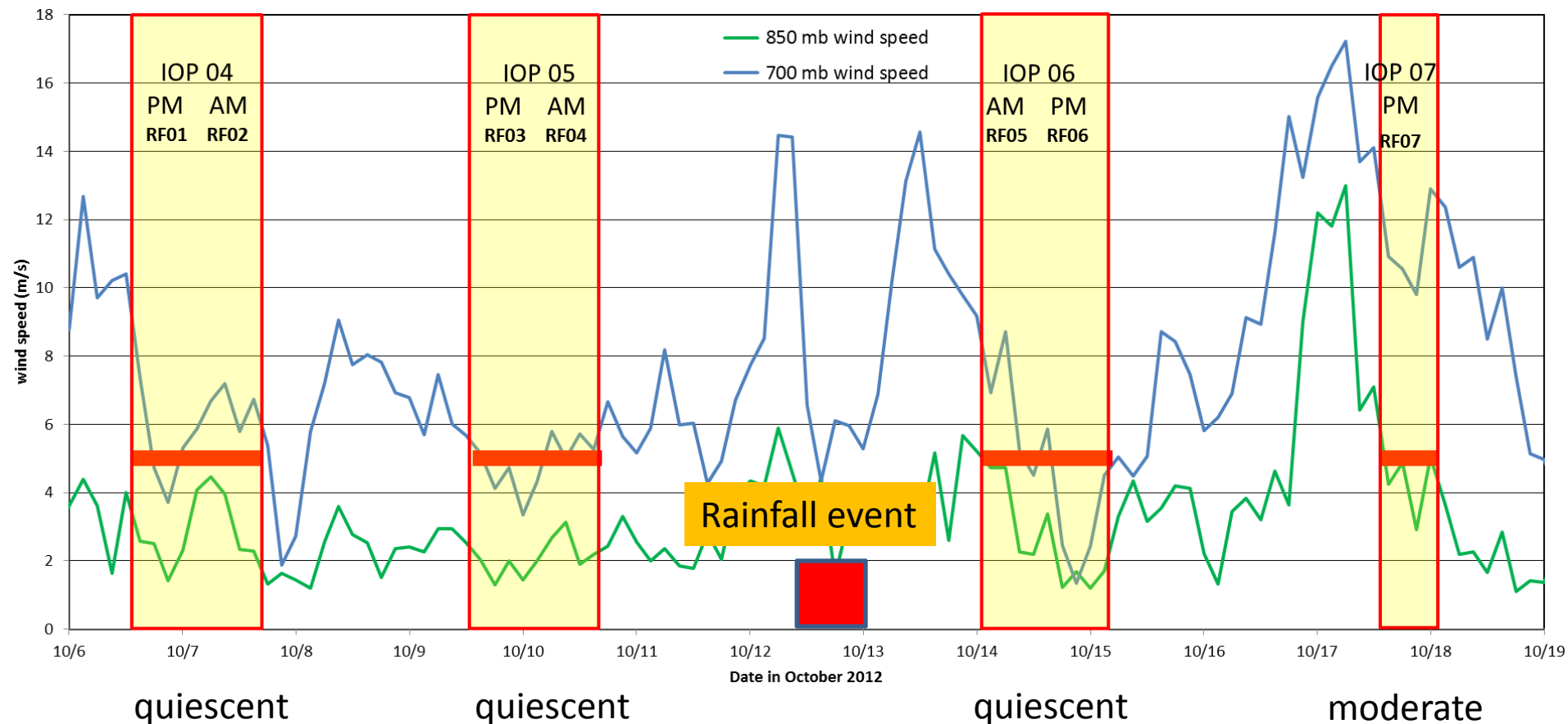
Main objectives of MATERHORN-airborne measurements

Provide MATERHORN with high resolution wind data at the mesoscale that provide the background information needed to interpret the many surface-based remote sensing and *in-situ* observations collected around Granite Mountain

Investigate spatial PBL structure and interaction of boundary layer flows with Granite Mountain

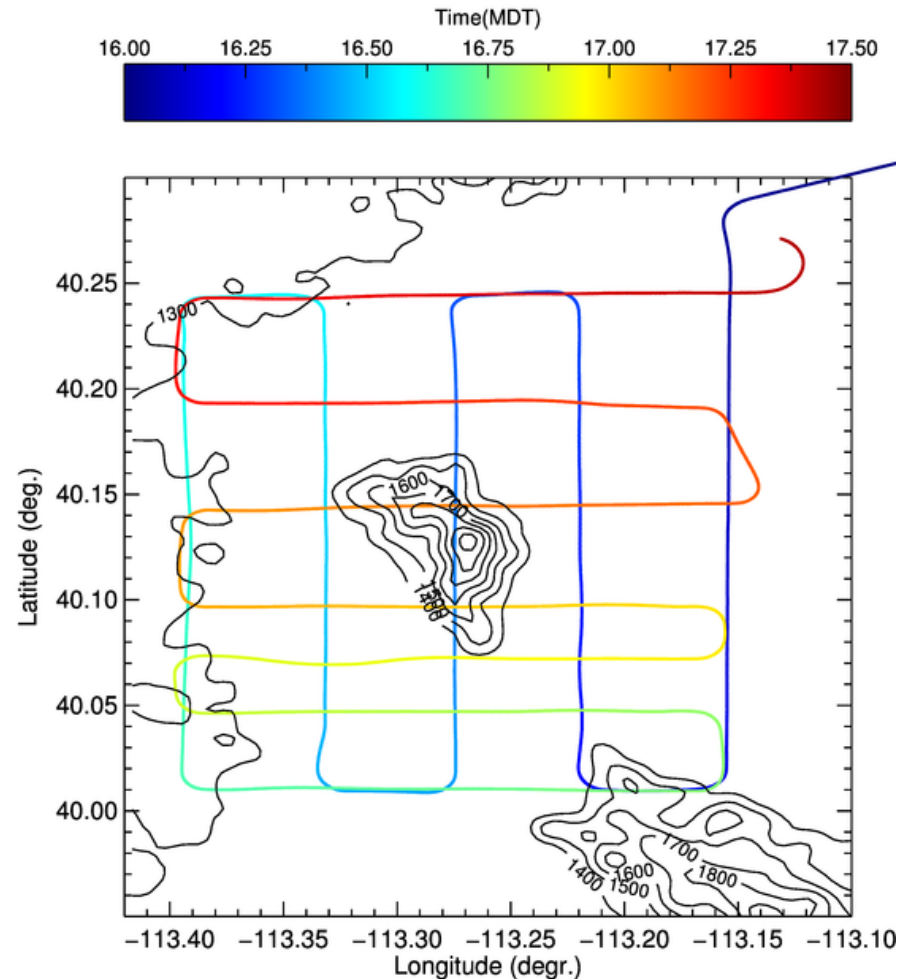
MATERHORN-X Fall - airborne

- Twin Otter in Utah between 5 October and 18 October, 2012, participated in 4 IOPs
- Missions lasted ~ 4 hours
- 7 research flights yielded ~3000 wind profiles between surface and 3400 m MSL



Example Flight pattern 09 October 2012

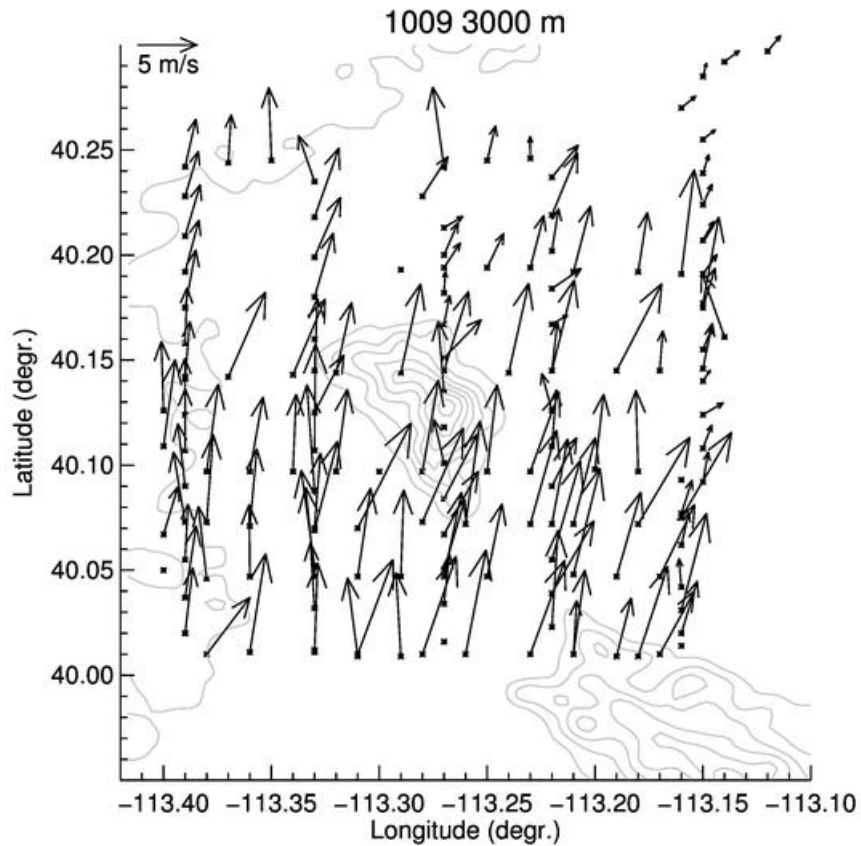
Afternoon flight (RF03)



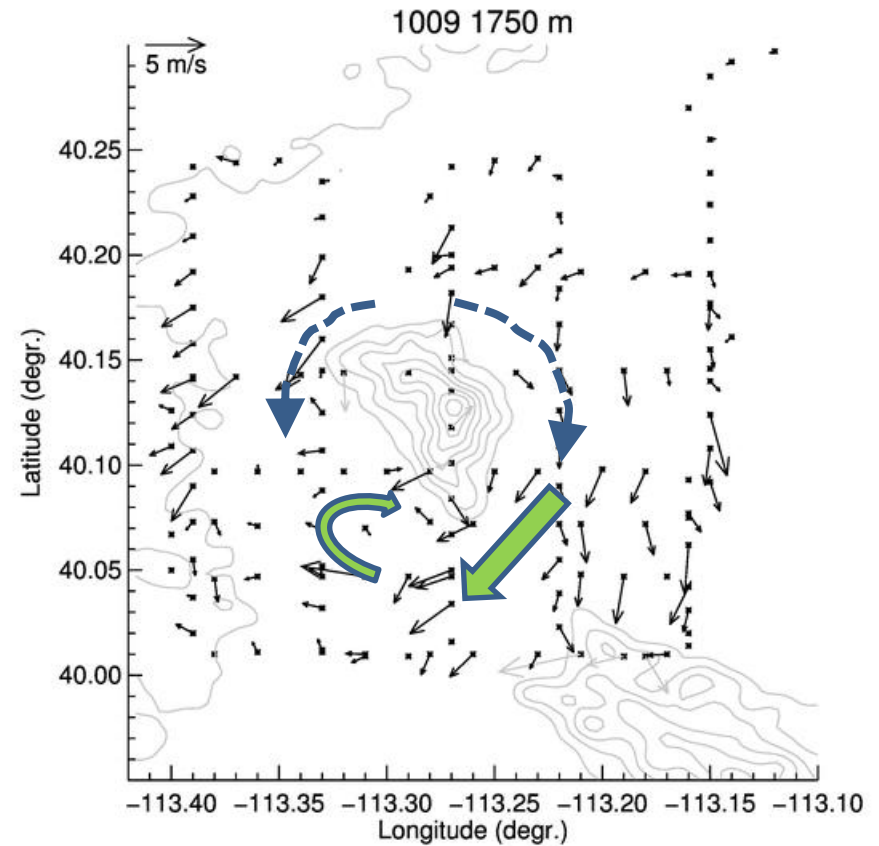
- Aircraft was based out of Salt Lake City ~ 20 minute to Granite Mountain
- Climb to ~ 4 km MSL (~1500 m above Granite Peak)
- North-south and east west legs of ~20-30 km
- Low level flights

wind pattern 09 October 2012

Upper-level flow

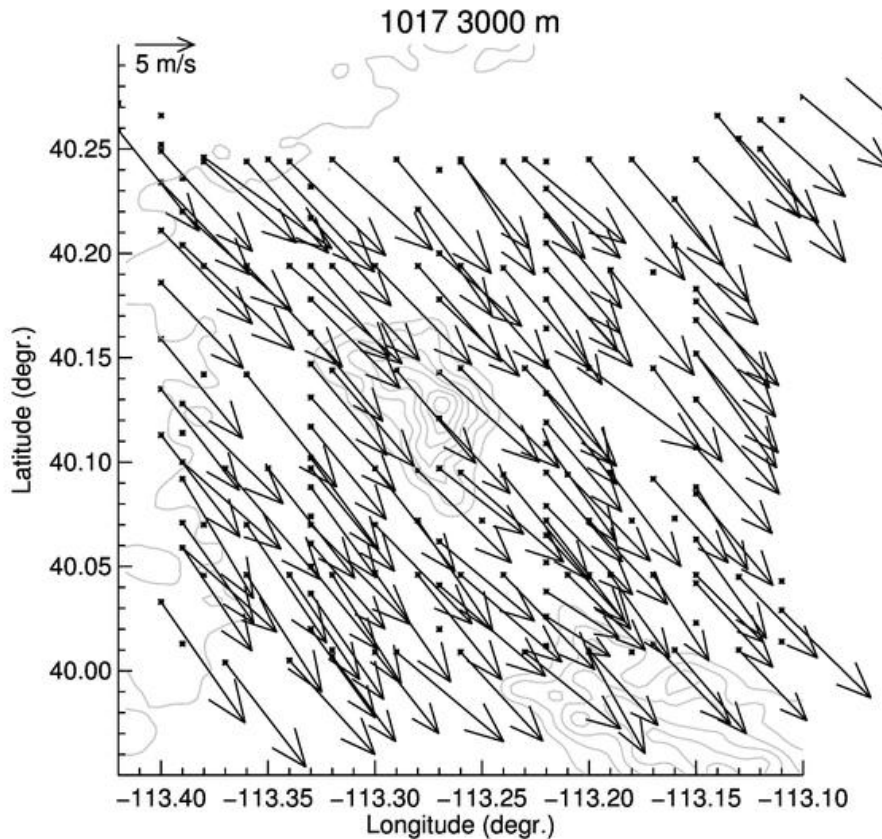


Near-surface flow (~400 m AGL)

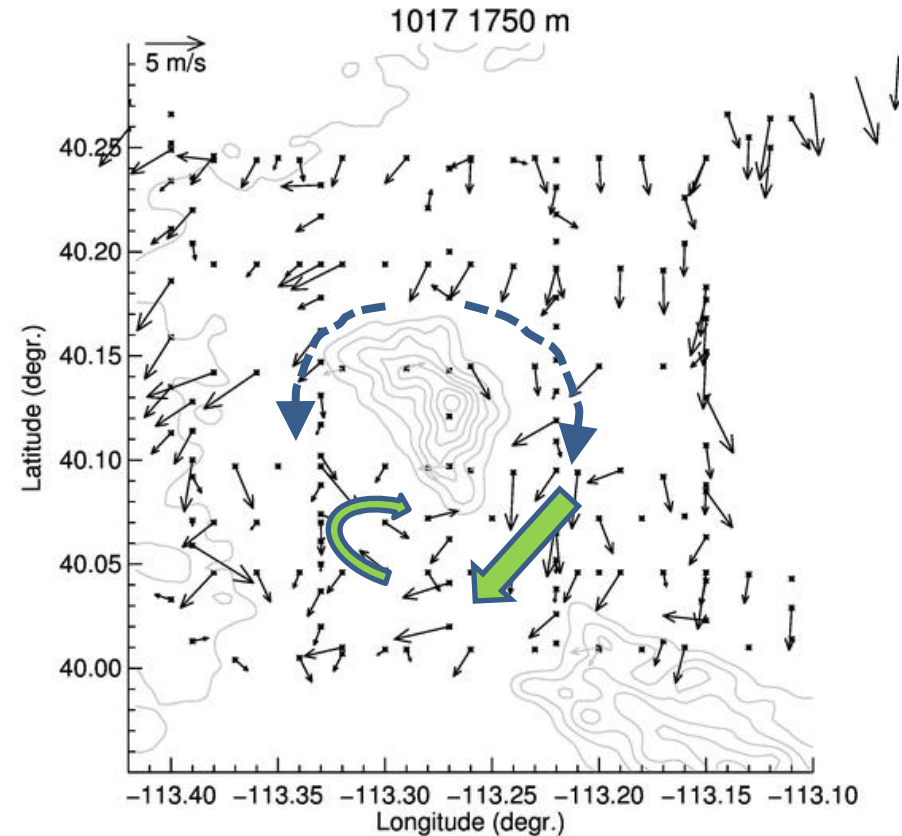


wind pattern 17 October 2012

Upper-level flow



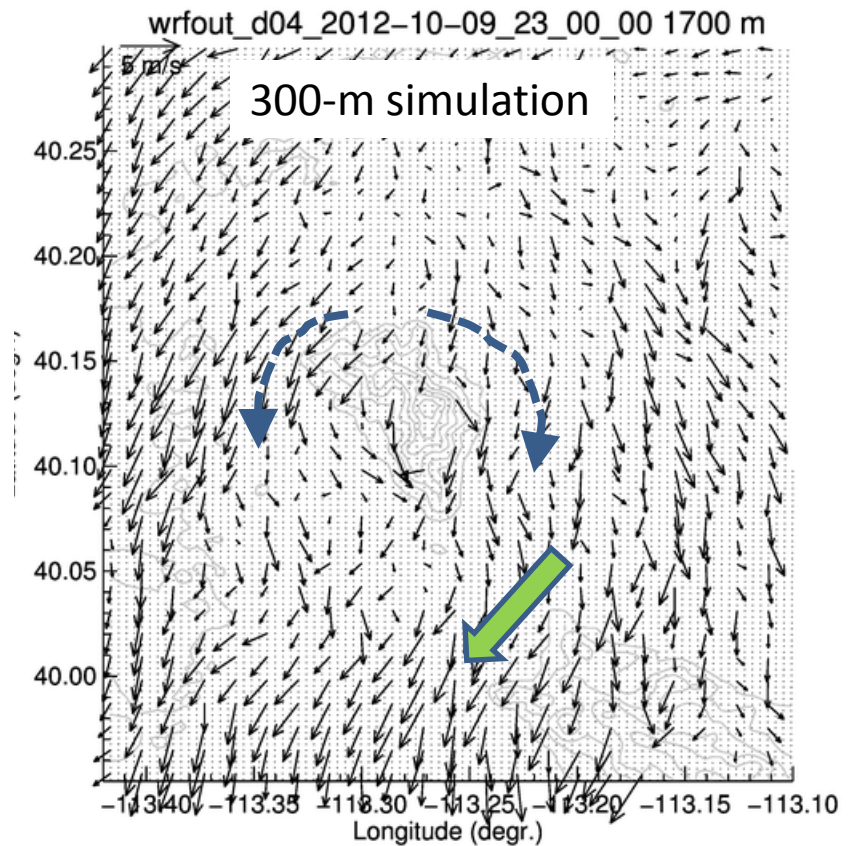
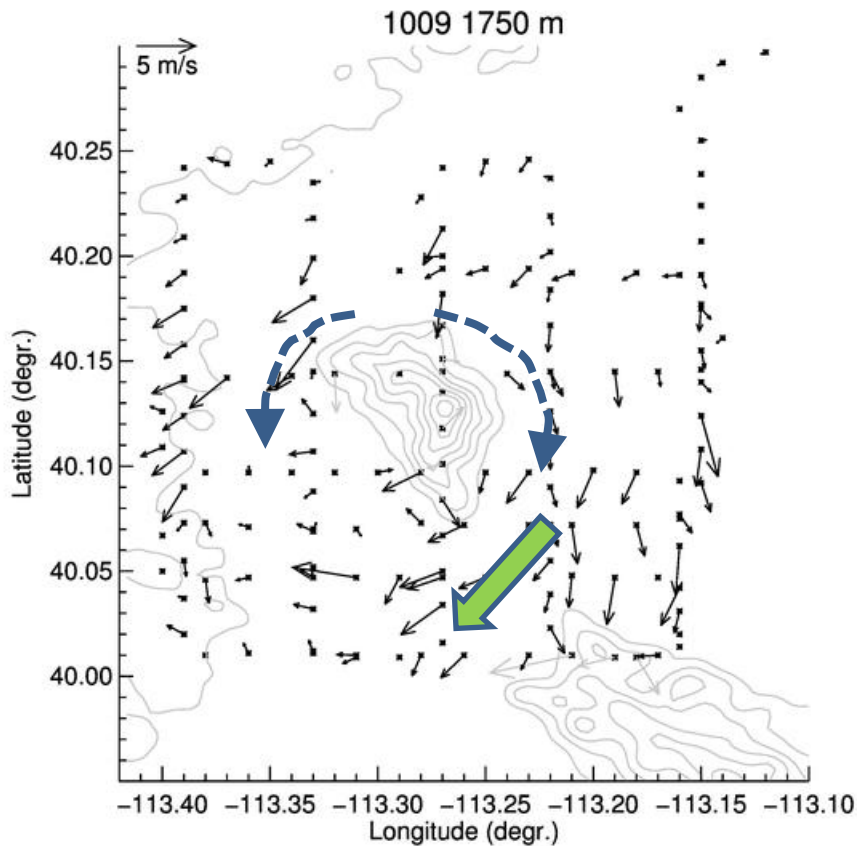
Near-surface flow (~400 m AGL)



Afternoon near-surface flow patterns appears unaffected by synoptic flow speed and direction

Preliminary example of comparison with Very Large Eddy Simulation (VLES) for Dugway Proving Ground

Near-surface flow (~ 400 m AGL)



Courtesy of Yubao Liu, NCAR

Summary

- 7 successful research flights were conducted during MATERHORN-X collecting data during 4 afternoons and 3 mornings in quiescent to moderate synoptic conditions
- Started an investigation of spatio-temporal variability of PBL structure and flow interaction with Granite Mountain
- recurring pattern of northerly thermally driven upvalley flows flowing around Granite mountain with channeling through gap.
- Very Large Eddy Simulation modeling at 300 m horizontal resolution – shows promising results

Outlook:

vertical velocities,

in-situ aircraft measurement, (fluxes!),

organized convective structures/thermal and interaction with flows,

assimilation of wind data from airborne Doppler lidar data in WRF,

LES simulation at 30-m planned for select cases

etc.

Acknowledgments: This research is funded by grants from the Office of Naval Research, the Army Research Office, and the National Science Foundation.