Measuring snow characteristics with the dual-polarization Doppler on Wheels (DOW) radar during ASCII

Katja Friedrich[1], Bart Geerts[2], Josh Wurman[3], Karen Kosiba[3], Josh Aikins[1], Evan Kalina[1]

[1]Department of Atmospheric and Oceanic Sciences (ATOC), University of Colorado, Boulder, CO
[2]Department of Atmospheric Science, University of Wyoming, Laramie, WY
[3]Center for Severe Weather Research, Boulder, CO

1. Motivation

A What is the 3-dimensional structure of radar reflectivity and dual-polarization parameters in orographic snowstorms?

B How does atmospheric stability, wind speed, and liquid water content impact snowfall intensity and the 3-dimensional radar structure?

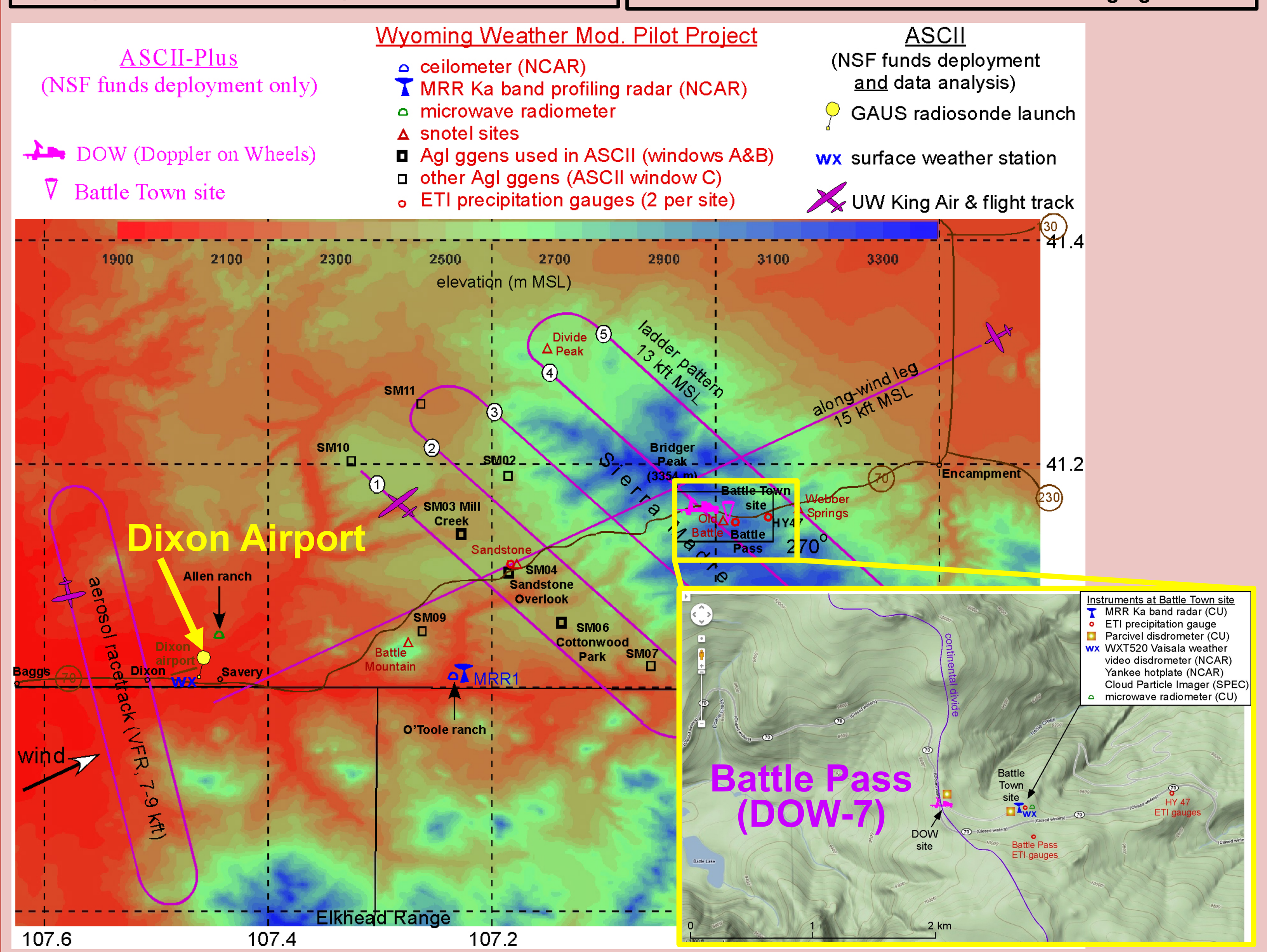
C Does glaciogenic cloud seeding of wintertime orographic snowfall modify radar parameters and effectively increase surface precipitation?

2. ASCII Field Experiment

- 17 Total IOPs
- January – March 2012
- Sierra Madre Mountain Range, WY
- AgI Cloud Seeding Experiment

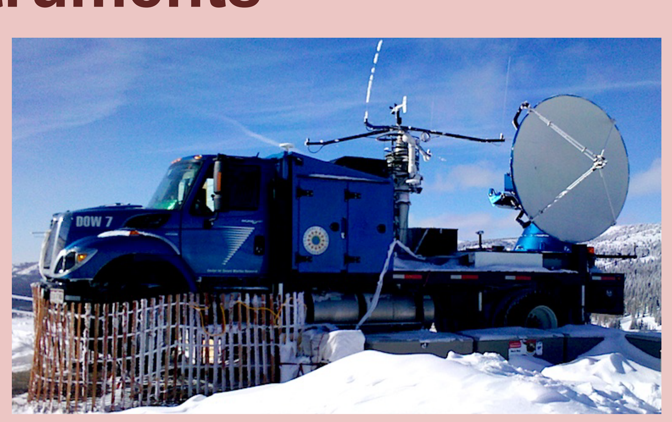
IOP 2 – January 16, 2012 (12:00 – 22:45 UTC)

- Cold front passage 18:15 UTC
- Temp at Battle Pass: -8°C to -15°C
- Temp at Dixon: 1°C to -6°C
- Wind at Battle Pass: 10 – 20 m/s from 260°
- Wind at Dixon: 5 – 10 m/s from 190° changing to 290°



3. Selected Instruments

Mobile, Dual-Polarization X-band Doppler On Wheels (DOW-7) Radar



Measures:

1. Reflectivity (Z)
2. Doppler velocity (V)
3. Differential reflectivity (Z_{DR})
4. Differential phase (Φ_{DP})
5. Co-polar Correlation Coefficient (ρ_{HV})

Microwave Radiometer

Measures:

1. Integrated Liquid Water Content (LWC)
2. Integrated Water Vapor (WV)
3. Temperature Profile
4. Humidity Profile

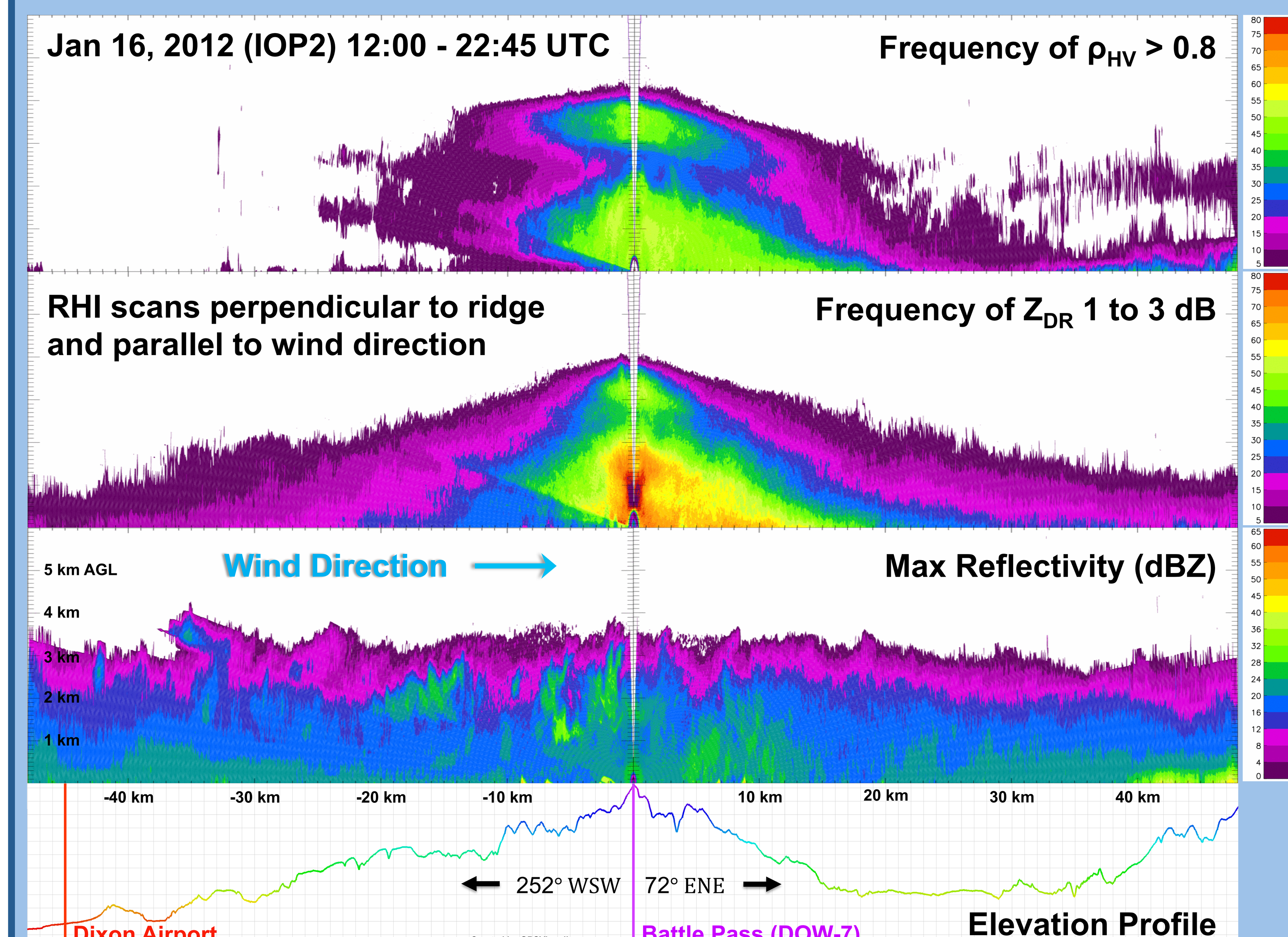
Microwave Rain Radar (MRR)

Measures:

1. Particle Fall Velocity Distribution
2. Particle Size Distribution

4.

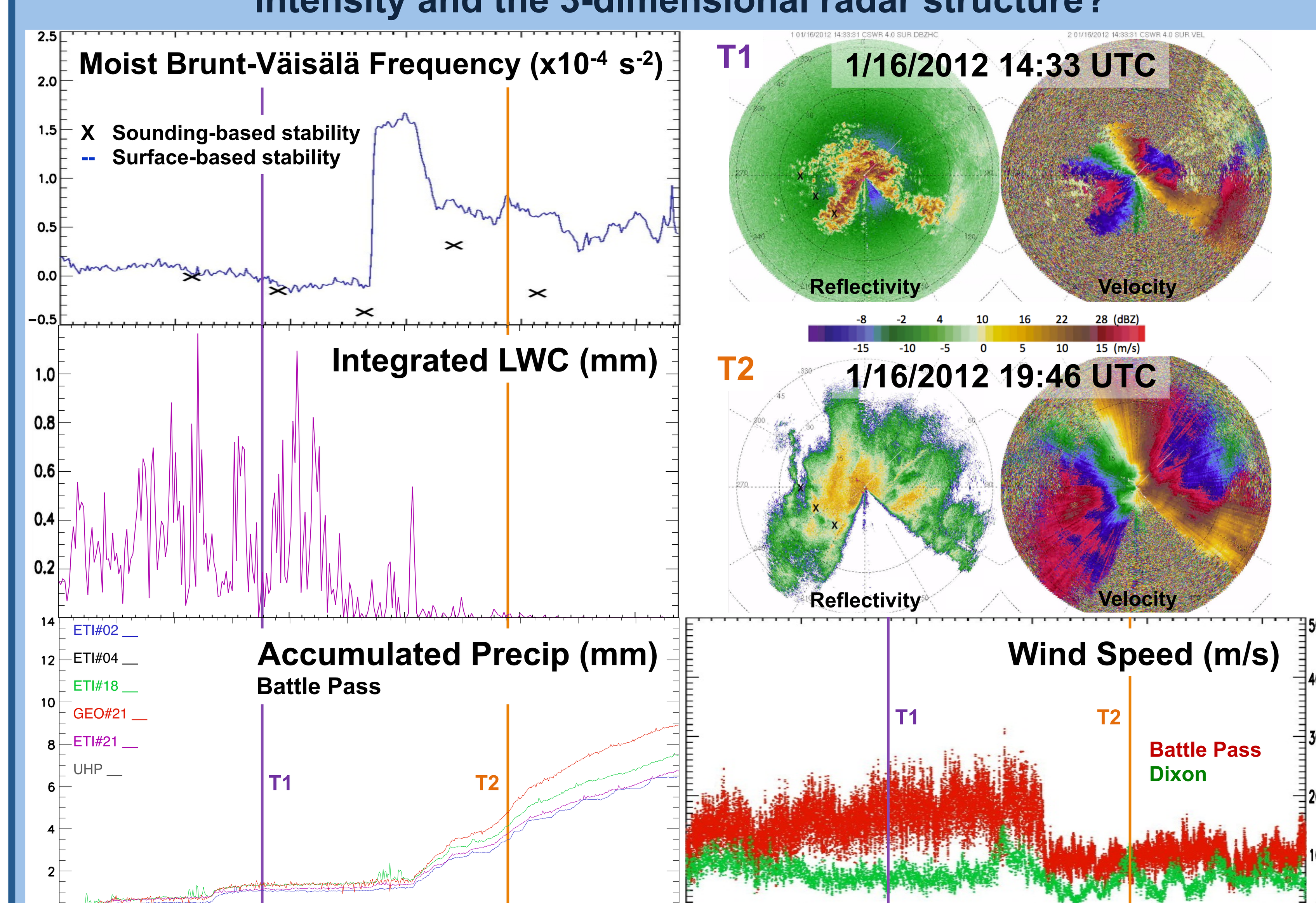
A What is the 3-dimensional structure of radar reflectivity and dual-polarization parameters in orographic snowstorms?



- Heaviest snowfall (higher reflectivity) at surface on leeward side of mountain
- Sharper precip structure on windward side of mountain with more uniform on leeward
- Mixed phase with oblate shape ±10 km of ridge with max at ridge $\rho_{HV} > 0.8$ & $Z_{dr} > 1$ dB
- Vertical structure of Z follows terrain on windward side

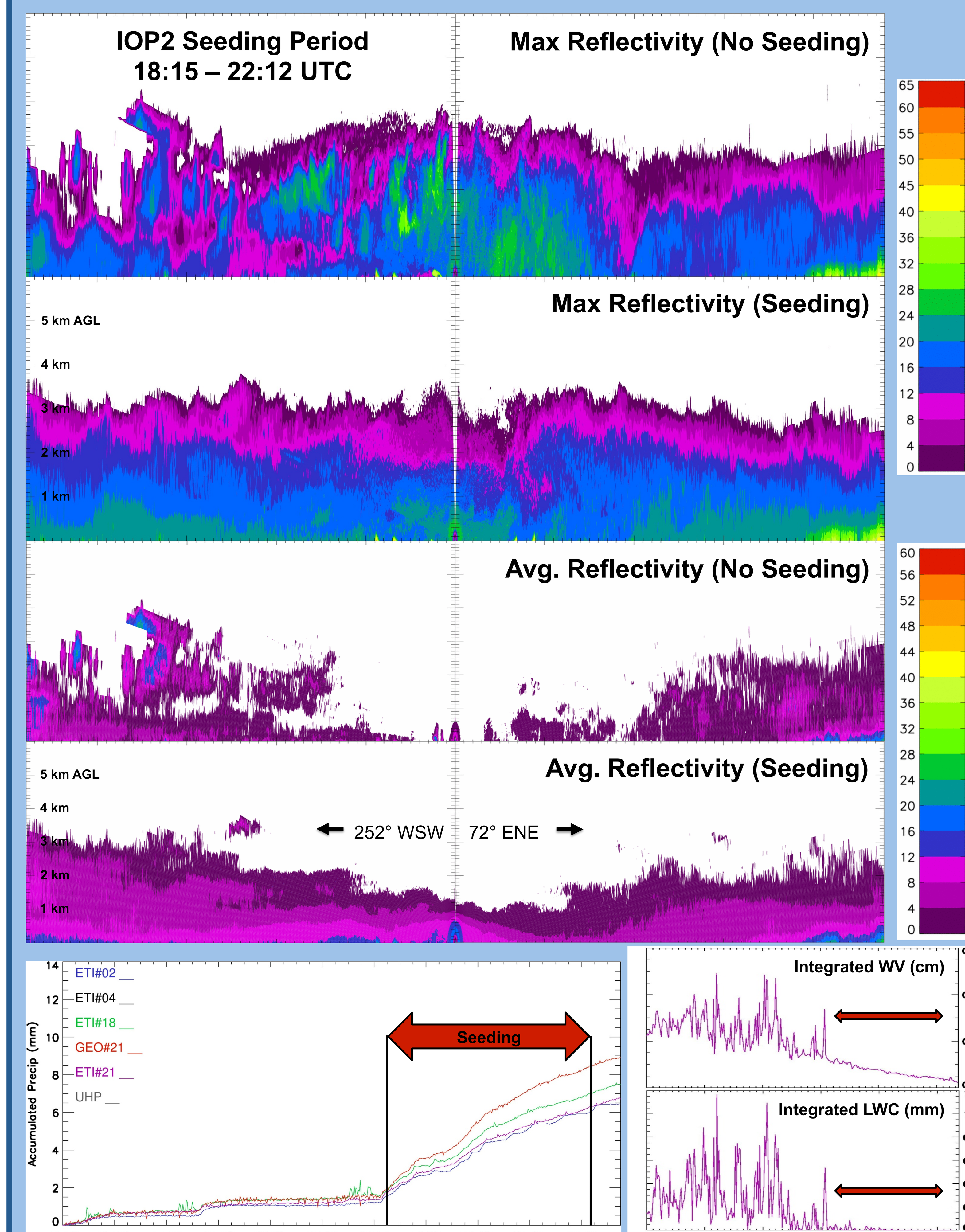
5.

B How does atmospheric stability, wind speed, and LWC impact snowfall intensity and the 3-dimensional radar structure?



6.

C Does glaciogenic cloud seeding of wintertime orographic snowfall modify radar parameters and effectively increase surface precip?



7. Preliminary Conclusions

A

- Precip increases near ridge of the mountain, indicating the presence of orographic forcing.
- Heavier snowfall at leeward side; windward side higher reflectivities aloft.
- A high occurrence of oblate particles near ridge, likely high density, horizontally-oriented particles.

B

- Precip increases after frontal passage ~18UTC; stable, no LWC, weaker winds, stratiform precip.
- Neutral stability, high LWC, and stronger winds with cellular precip structures prior to front.
- Strongest winds not correlated with heaviest snowfall.

C

- Heaviest snowfall at Battle Pass postfrontal during cloud seeding time.
- No increase in cloud depth observed during seeding period.
- More convective precip structure during non-seeding period with high Z at higher altitudes.
- More stratiform precip structure during seeding period with highest Z at lower altitudes.

Acknowledgements

This research was sponsored by the American Meteorological Society's Graduate Fellowship Program. We thank Evan Kalina of ATOC for collecting data at Battle Pass. Thank goes to the scientists at the CSWR for providing quality controlled DOW-7 radar data as well as Scott Landolt, Dan Breed, Roy Rasmussen of NCAR for providing access to the precipitation data.