The Storm Peak Lab Cloud Property Validation Experiment (STORMVEX)

An ARM Climate Research Facility

AMF2 Maiden Deployment

Project Team:

- **Jay Mace (PI), University of Utah**
- **Sergey Matrosov, CIRES, University of Colorado and NOAA/ESRL**
- **Matthew Shupe, CIRES, University of Colorado and NOAA/ESRL**
- **Paul Lawson, Stratton Park Engineering Corporation**
- **Gannet Hallar, Desert Research Institute**
- **Ian McCubbin, Desert Research Institute**
- **Roger Marchand, University of Washington**
- **Brad Orr, Argonne National Lab**
- **Rich Coulter, Argonne National Lab**

From the ARM Science Plan, circa 2004:

“It is critical for ARM to produce a continuous, complete, and rigorous description of the atmospheric physical state in the vertical column above the ARM core instrument facilities. This description must include … {simultaneously} bulk cloud { and precipitation} properties such as condensed water
contents and mean particle size.”

The objectives of StormVEx are to,

1. Provide a continuous correlative remote sensing and in situ data set to the ARM Archive that consists of routine ARM active and passive remote sensing measurements, with coincident in situ microphysical cloud and precipitation observations that are suitable for validation of remote sensing retrieval algorithms.

2. Produce an ACRF data set in a region of complex terrain - a long standing goal of ARM

3. Document the role of aerosols, both natural and anthropogenic, in cloud and precipitation
processes.

The Storm Peak Lab Cloud Property Validation Experiment (StormVEx)

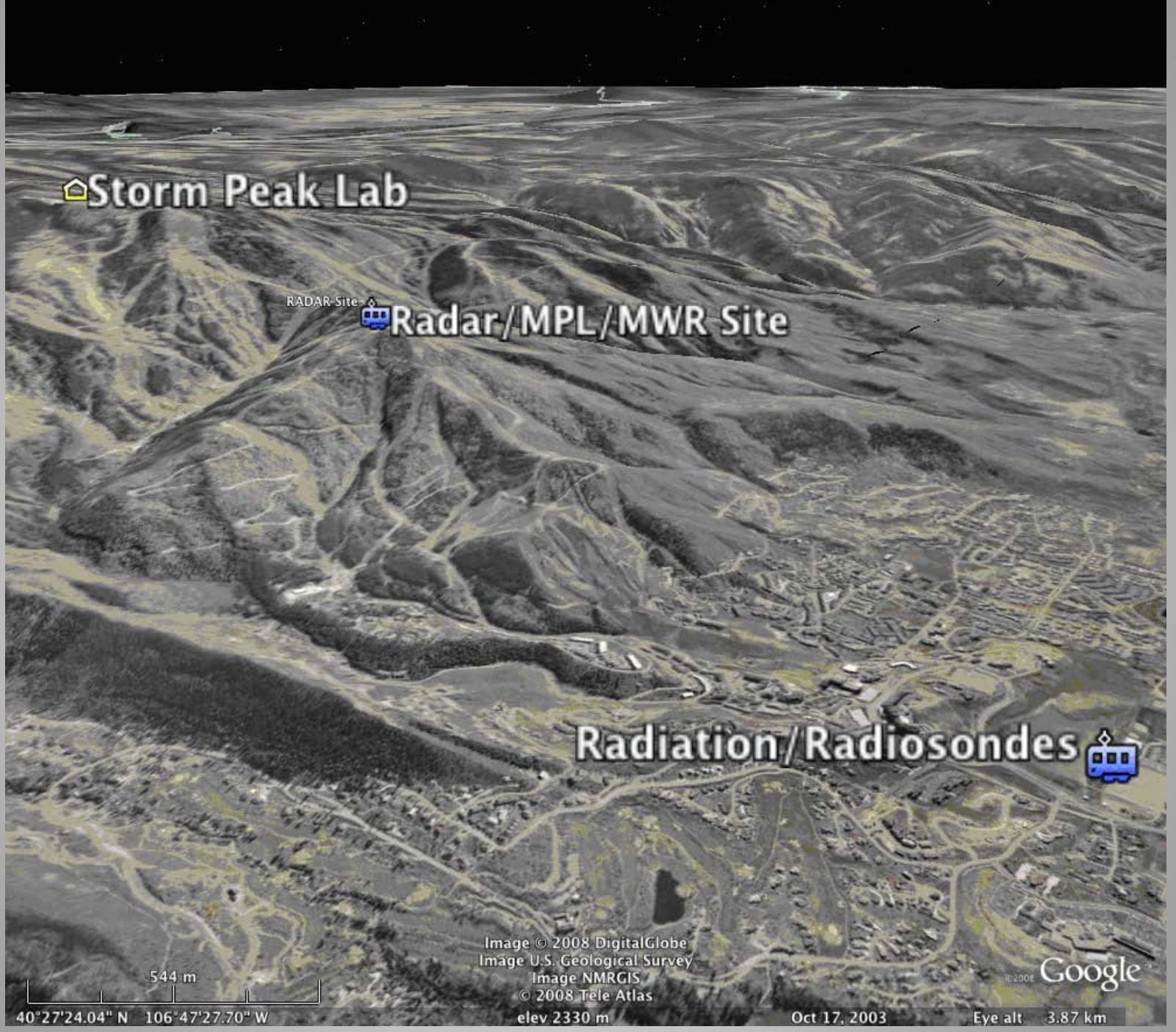
What: Deployment of the 2nd ARM Mobile Facility to Steamboat Springs Colorado to operate in close coordination with Storm Peak Lab

When: October 2010 – March-April 2011 (whenever the snow melts)

Why: Primary objective – Use SPL as in situ data collection platform for validation of cloud properties retrieved by ground-based remote sensors

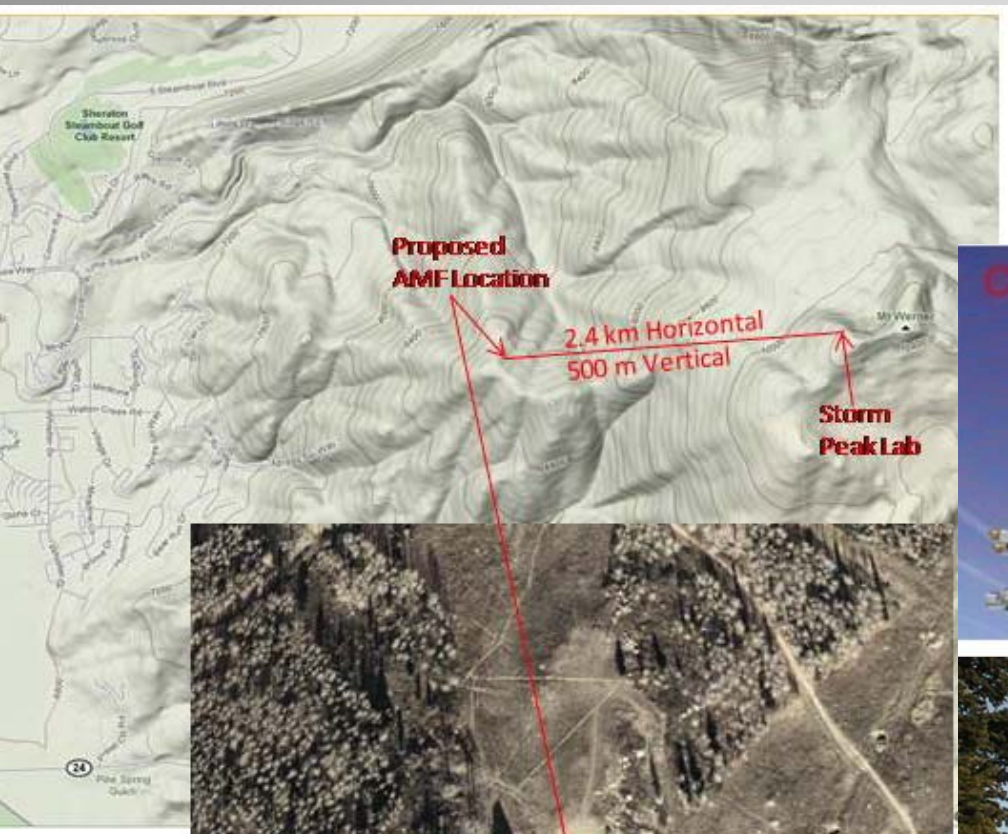
The Storm Peak Lab Cloud Property Validation Experiment

Anticipate > 1000 hours of correlative in situ and remote sensing data during StormVEx!!

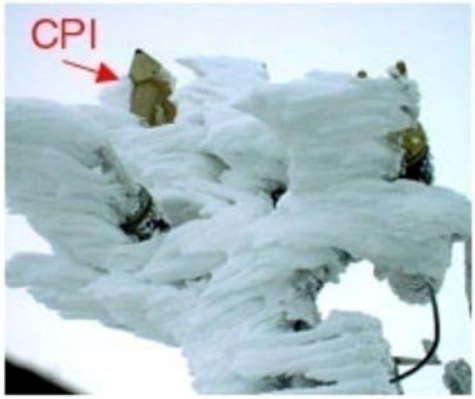

Storm Peak Lab
RADAR Site
Radar/MPL/MWR Site
Radiation/Radiosondes
Image © 2008 DigitalGlobe
Image U.S. Geological Survey
Image NMRGIS
© 2008 Tele Atlas
544 m
Google
40°27'24.04" N 106°47'27.70" W
elev 2330 m
Oct 17, 2003
Eye alt 3.87 km

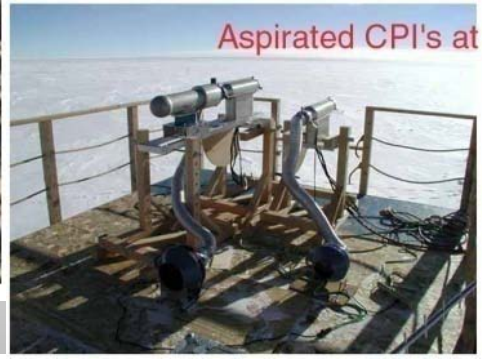
Burgess Creek
Storm Peak
Labratory
Mt.
Werner
3200m
AMF2 Location
Radar/MPL/MWR
40
Burgess Creek
Walton Creek Rd
Valley Floor Site
Radiation, Radiosondes
and, 915 MHz Wind Profiler
Proposed
AMF Location
2.4 km Horizontal
500 m Vertical
Mt.
Werner
3200m
Storm
Peak
Labratory
N

The Storm Peak Lab Cloud Property Validation Experiment

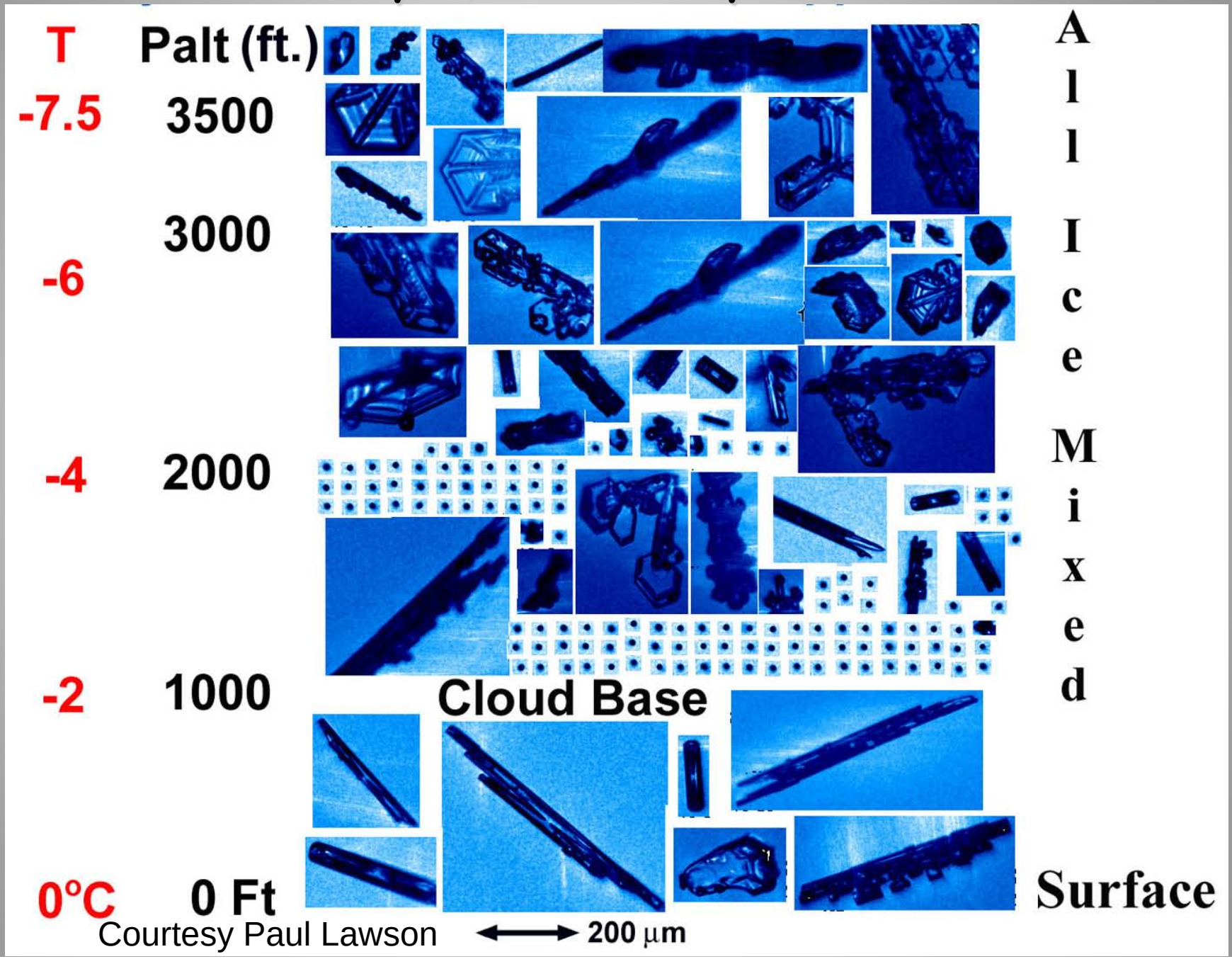


Cloud Probes from SPEC will augment the SPL probe array





May 7, 2008 in Ny-Ålesund



Courtesy Paul Lawson

Doppler Spectra Analyses in “Mixed-Phase” Clouds

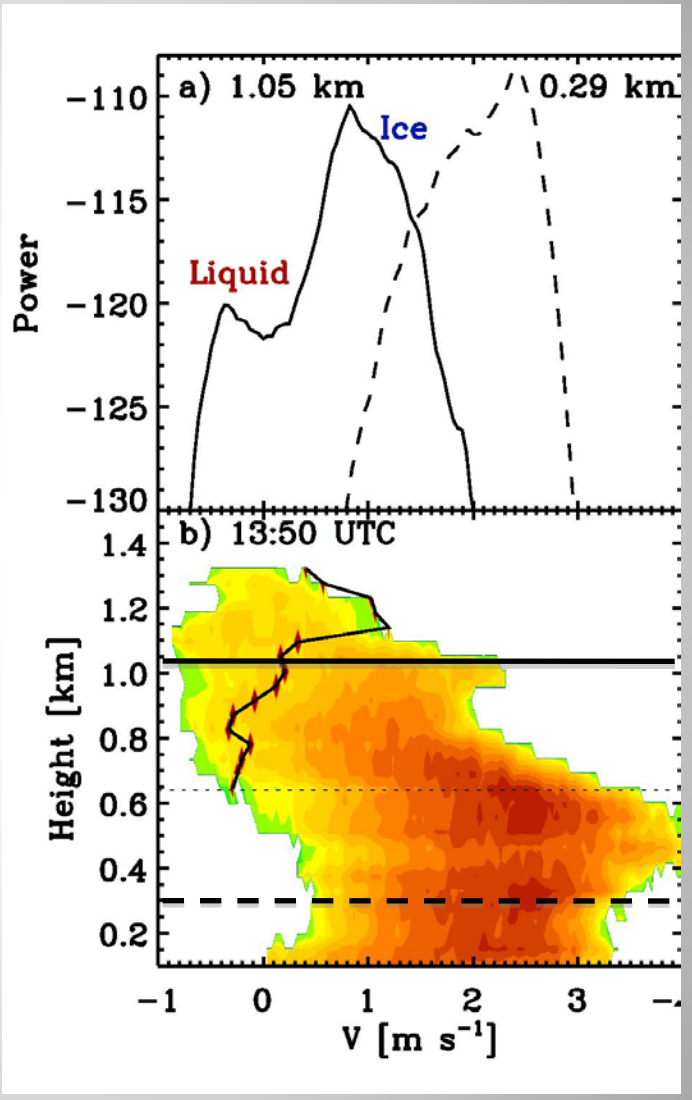
• Graphic (bottom) shows returned power as a function of Doppler velocity (i.e. Spectra).

•Graphic on top extracts power spectra from two heights – 0.29 Km (dashed) and 1.05 km (solid)

•“Mixed-Phase” spectrum near cloud top has distinct contributions from both liquid and ice particles (bimodal).

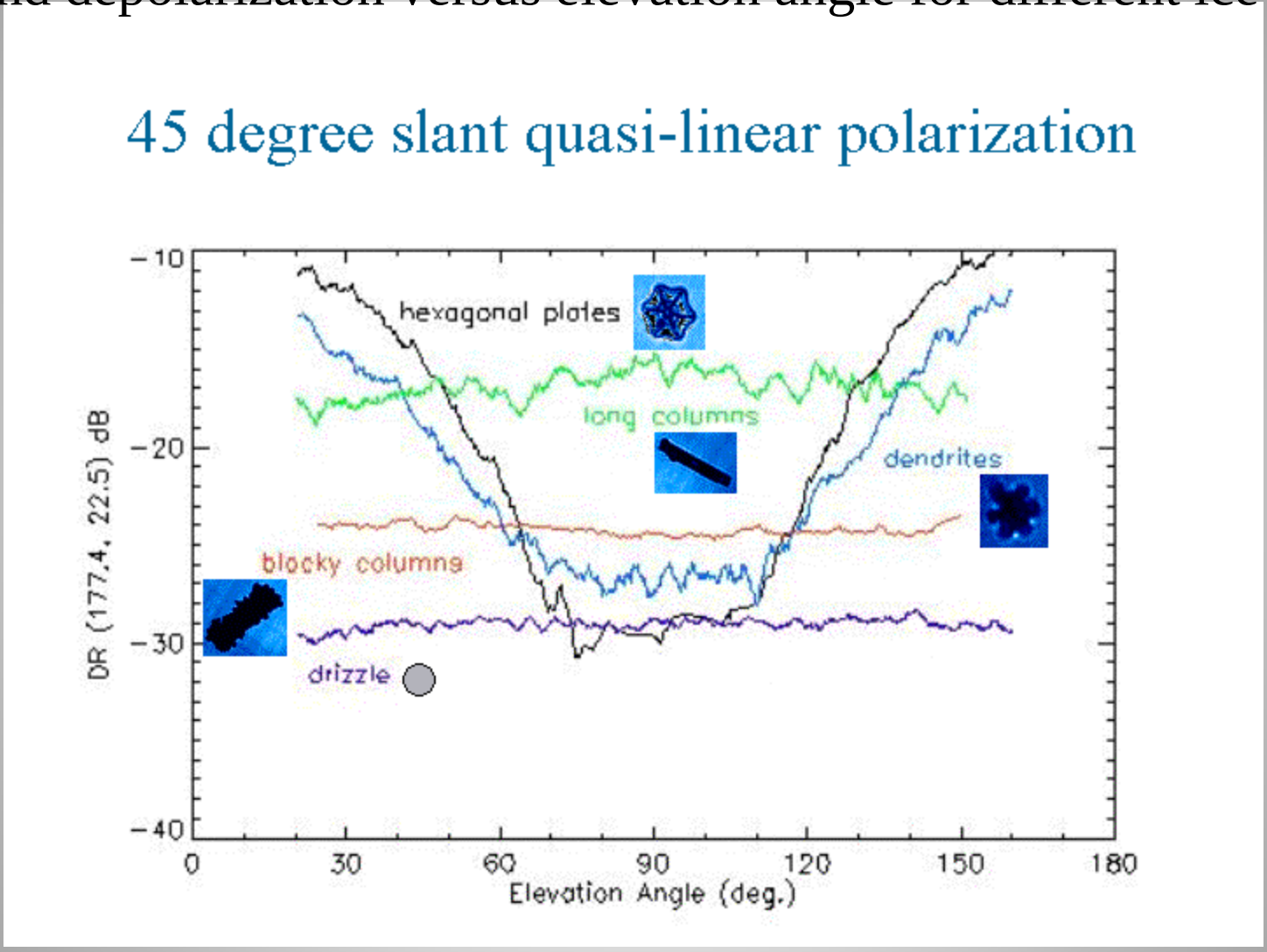
• Spectrum near the surface (0.29 km) is characteristic of ice/snow (monomodal)

• In some cases the contributions from each phase can be distinguished and used for retrievals.



StormVEx Question: Can these distinctions be made in orographic clouds with snow flakes, water droplets, and active dynamics?

K_a-band depolarization versus elevation angle for different ice crystals



Summary:

•Lots - ½ Lots of time for planning and getting involved….

• Beyond the core science objectives, there will be many secondary objectives:
  - Aerosol dynamics, chemistry, and indirect effect
  - Modeling of the meteorology and precipitation in complex terrain
  - etc…

• Breakout session Thursday at 3 pm.

AMF2	Measurement	Location	Operation Plans	Calibration History/plans	Level 1 Data Availability	Level 2 Plans
SWACR Spectra	Z(Vd) ???point fft Co and cross polarization spectra (45 degrees) ??	Thunderhead	Scanning Strategy (Action item for Sergey) 24/7	Corner Reflector and Rain, Will disdrometers exist?, intercomparison	Possible download. Likely.	
SWACR Moments	Reflectvity Velocity Spectrum Width	Thunderhead	Scanning Strategy 24/7			
MPL Backscatter	Attenuated Backscatter (co and cross pol)	Thunderhead	Operate 24/7	Overlap will be done at SPL…	VAP MPLNOR	Optical depth/extinction retrievals –
AERI	IR Spectral Radiance	Thunderhead	24/7, Rapid Scan critical	Established	No issues/ spectra	
Microwave Radiometer	23, 31, 90 GHz	Thunderhead	Scanning strategy (Rich action)	Tip Calibration routine	Normally available	Retrievals- MWR Ret - VAP
MFRSR	Spectral Flux	Thunderhead	24/7	Langley Calibration (who?) Cal exercise	Normally available	VAP – Connor/Qilong
Long's Radiometer	IR and solar flux					

AMF2	Measurement	Location	Operation Plans	Calibration History/plans	Level 1 Data Availability	Level 2 Plans
915 Profiler	Z(Vd), V, W	Valley Floor	Mode/beams operation. High vs low modes #fft Scanning strategy? Order?	Disdrometer at the valley floor for calibration.	Z(Vd)	winds
Vaisala Ceilometer	Profiles of backscatter	Valley Floor	24/7	n/a	backscatter	Cloud base, mixing height,
Skyrad, Groundrad	Solar and IR Fluxes	Valley Floor	24/7	ARM bore cal process		Best estimate VAP needs to be run
Total Sky Imager	Sky Images	Valley Floor	Daylight	n/a	Imagery?	movies? Cloud fraction – VAP??
BBSS	P, T, Rh, Wind Profiles	Valley Floor	2 per day always. 4 per day sometimes. Occasionally more?		Routine	None
ECOR		Valley Floor				

SPL Instruments	Measurement	Location	Operation Plans	Calibration History/plans	Level 1 Data Availability	Level 2 Plans
PIP	Raw data needed 100 microns to 6.5 mm.	SPL	Whenever particles are around	Cal by dmt prior.	Raw data will be provided	Processing in plans.
fssp	Psd 1-50 microns	SPL	Whenever particles are around	Calibrated by dmt	Raw data to be preserved	Size distributions
Ccn counter	Number per cm3 per ss%	SPL	24/7	DMT calibration	Available upon request	n/a
Smps (scanning mobility particle sizer	8-500nm size distribution	SPL	24/7	TSI calibration annually; Not mission critical		
APS (aerodynamic particle sizer)	500nm to 20 microns	SPL	24/7	TSI calibartion annually; Not mission critical		
(U)Cpc (ultra)(condensation particle counter)	Aerosol concentrtion 10 and 3 nm cutoffs	SPL	24/7	TSI calibration annually; Not mission critical		
Trace gasses (ozone and co2)		SPL	24/7	Not mission critical		

SPEC	Measurement	Location	Operation Plans	Calibration History/plans	Level 1 Data Availability	Level 2 Plans
CPI	Particle Imagery	SPL				
Fast FSSP	1-50 micron PSD	SPL				
2D-S	10-3000 micron PSD	SPL				
HVPS	0.2-5 cm PSD	SPL				
Extinctiometer	Extinction	SPL				
Nevzorov	Total water mass	SPL				
Rosemont icing probe		SPL				

Science/Ops Plan Proposed Outline:

1.Updated science goals and objectives - Jay
2.Physical Locations – Role of each site in Stormvex science goals. (Jay)
    1. Thunderhead
    2. Valley Floor
    3. Christy Peak
    4. Storm Peak Lab
3.Measurements and data streams – Expected science role of each data stream. What are our expectations from each data stream? What part will each data stream play in achieving our science goals? (Roj)
    1. Break this out either by physical location, or by science goal, or by…?

4.Operation of instrumentation – Instrumentation, power, comms, and other relevant issues, discuss operational modes, routine maintenance, etc.
    1. SPL (Gannet)
    2. Thunderhead (Rich Coulter) Radar Scanning Strategies
    3. Christy Peak (Art)
    4. Valley Floor (Rich Coulter)
    5. others - Camps (Gannet)
5.Operational Modes - How will operations change as a function of the weather? Nice weather, clouds on the peak without much precip, clouds on the peak with light snow, blizzard (Matt)
    1. Radar scanning strategy (Sergey)