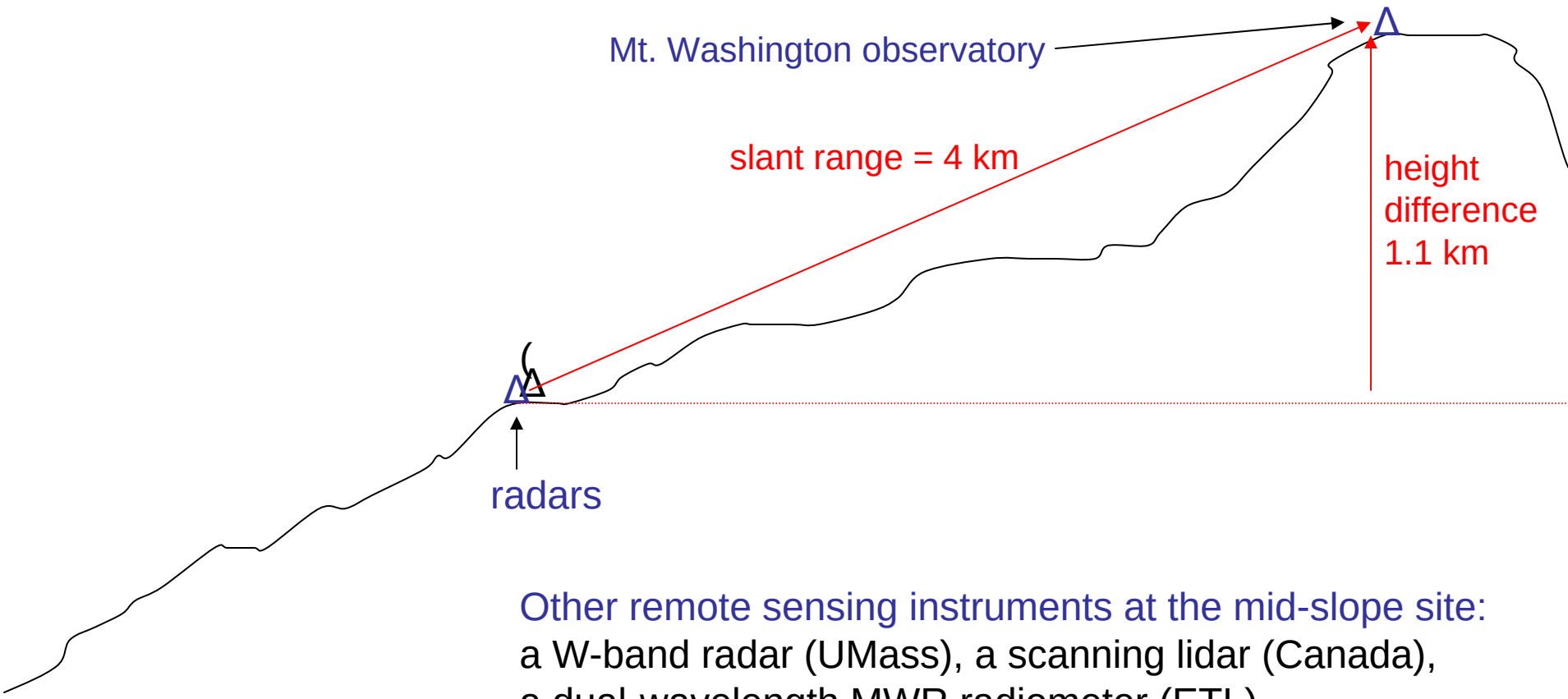
# Some highlights of the MWISP field project and its relevance to StormVEx

Sergey Matrosov

# MWISP field experiment: April 1999, Bretton Woods , NH

## MWISP = Mount Washington Icing Sensors Project

NOAA ETL deployed $K_a$- and X-band scanning radars at the mid slope of Mt. Washington




Other remote sensing instruments at the mid-slope site:
a W-band radar (UMass), a scanning lidar (Canada),
a dual-wavelength MWR radiometer (ETL).

## The main ETL's MWISP task:

To test $K_a$- band polarimetric scanning radar techniques
to detect supercooled large droplets (SLD).

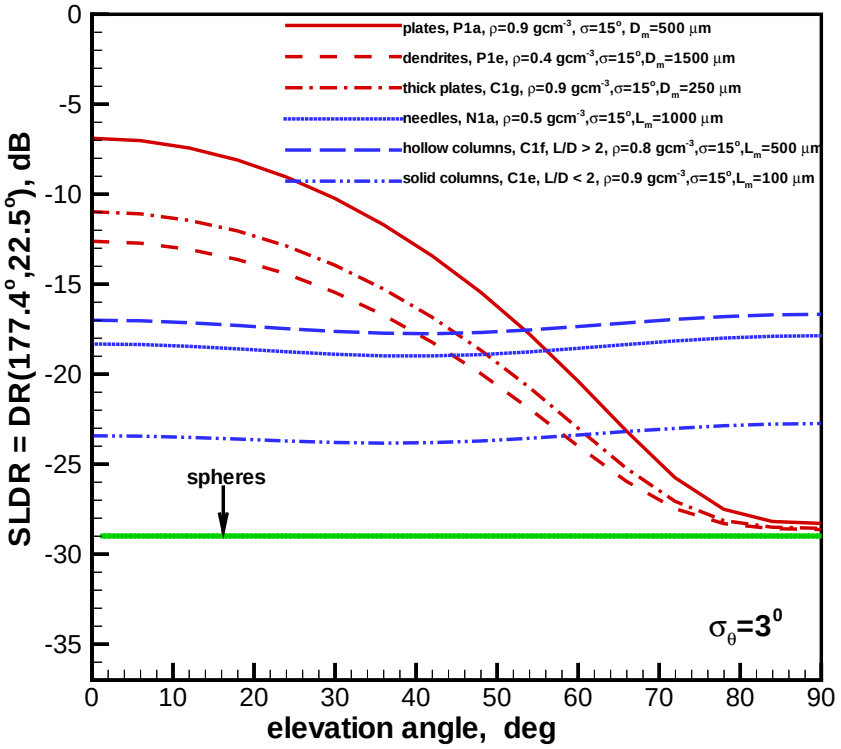
---

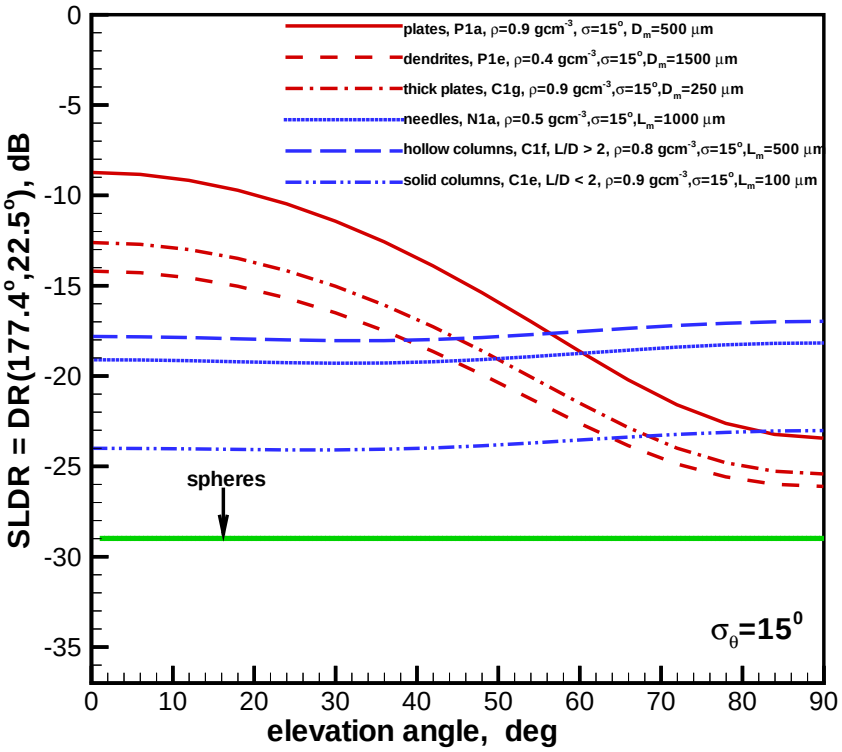
SLD (e.g., freezing drizzle drops with sizes 30 – 400 μm) cause a significant aircraft icing hazard and usually are accompanied by few to no ice crystals

Small supercooled liquid drops that often co-exist with ice crystals are usually responsible only for minor rates of aircraft performance degradation

$K_a$-band SLDR ($SLDR=10\log_{10}(Z_{45deg135deg}/Z_{45deg45deg})$) was the polarimetric parameter used for discriminating different habits of atmospheric hydrometers

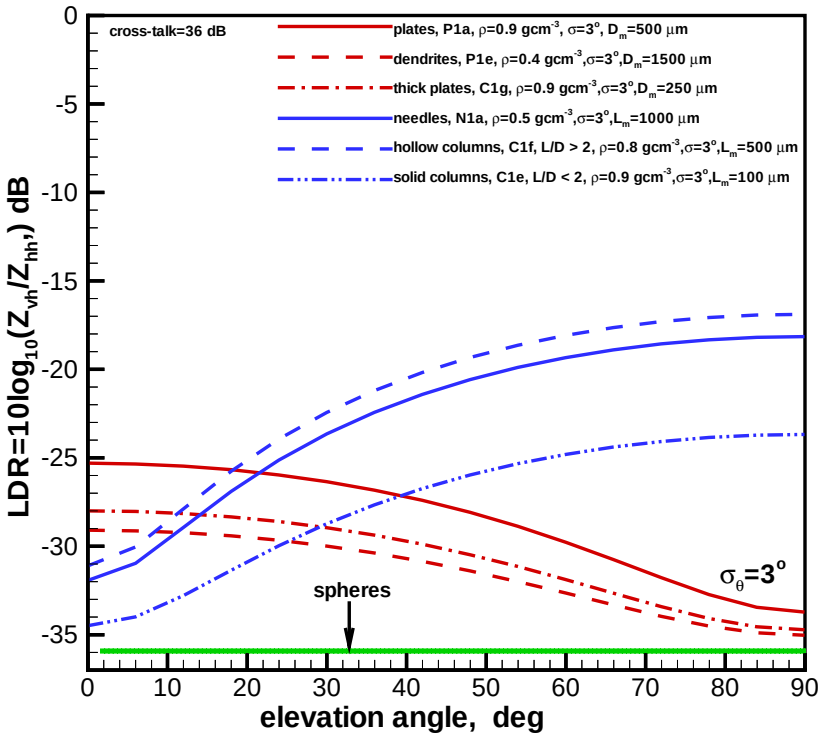
SLDR allows distinguishing among planar and columnar ice crystals and also spherical SLD when performing RHIs

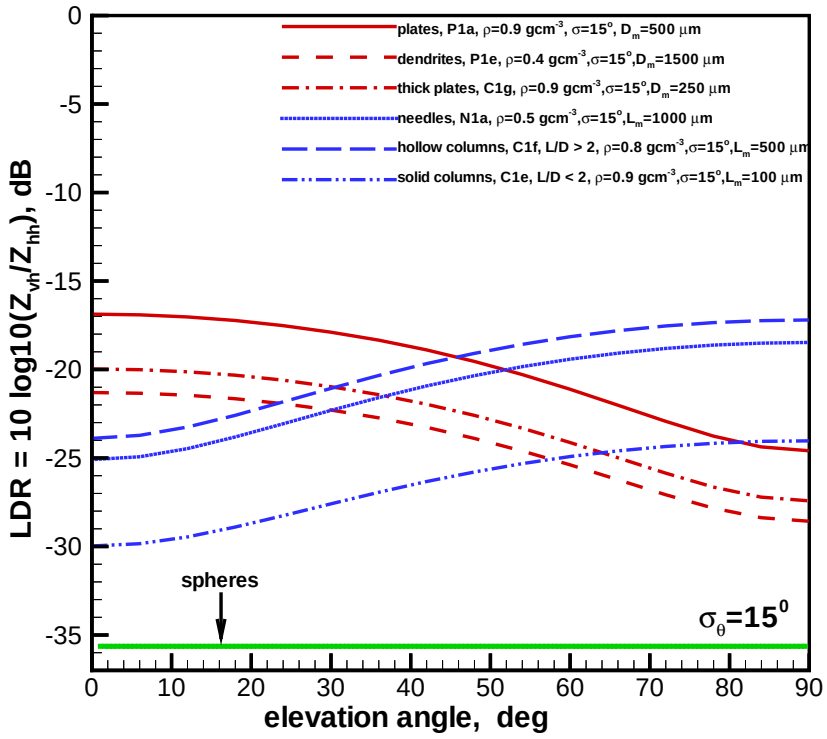


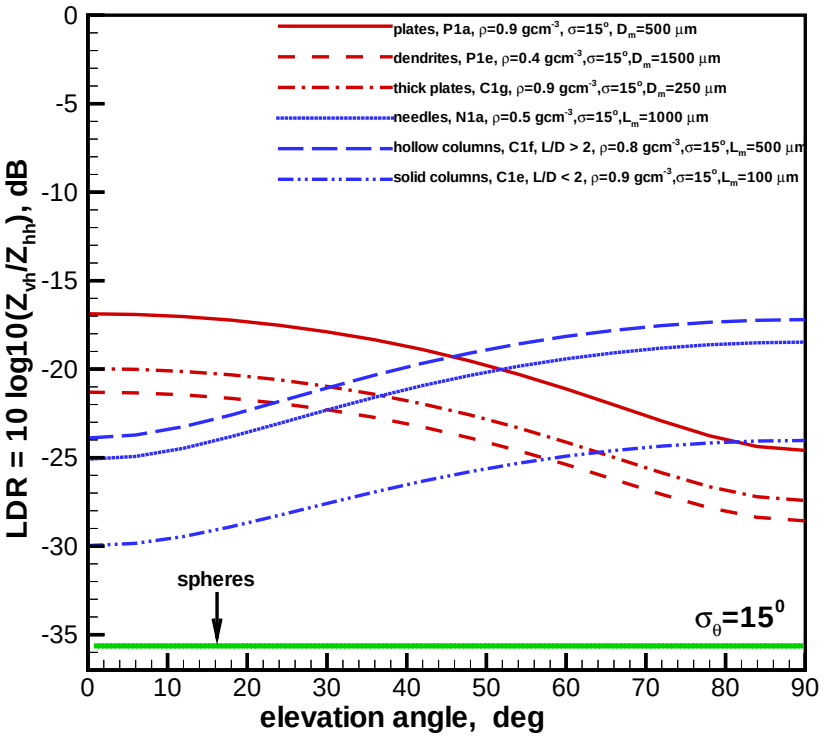
# SLDR is superior to conventional H-V LDR for discriminating hydrometeor shapes

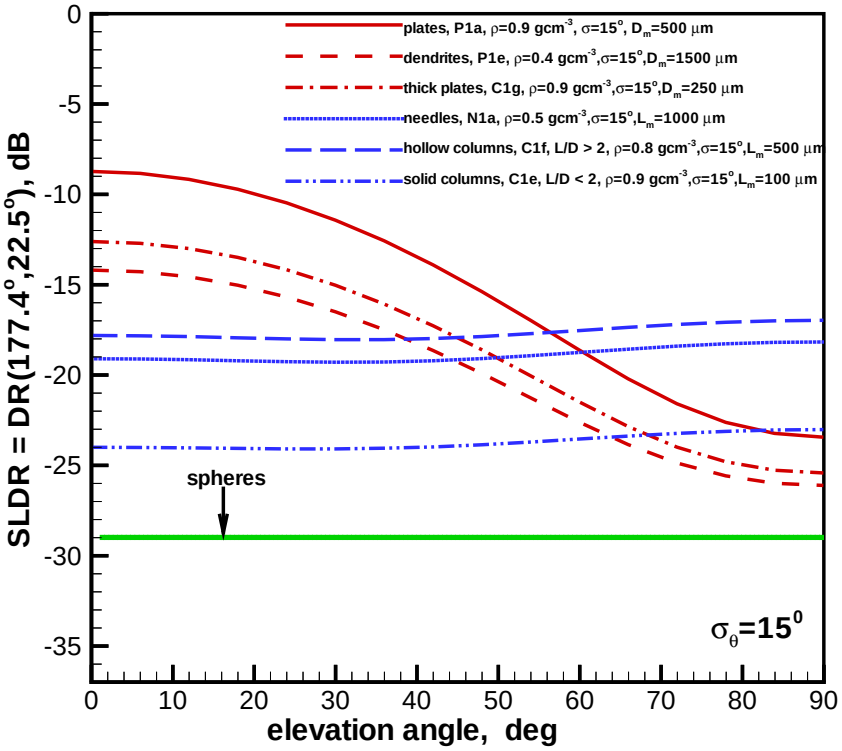
(SLDR depends on hydrometeor orientation only slightly while LDR depends on hydrometeor orientation strongly)



# SLDR is superior to conventional H-V LDR for discriminating hydrometeor shapes



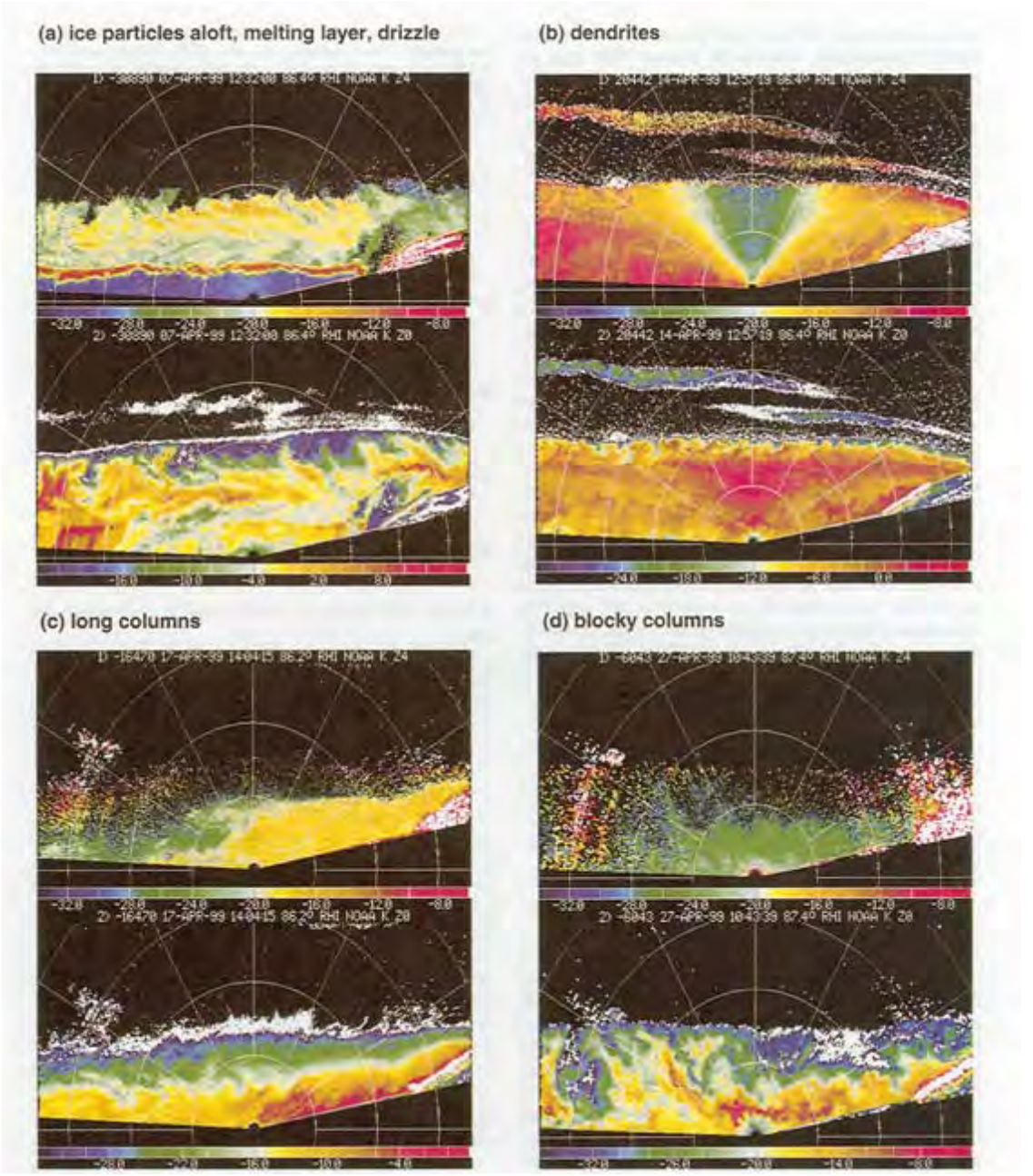



Depolarization by regular (pristine) ice crystals and warm drizzle (a)

SLDR – top of each frame
Blue: SLDR < -28 dB
Green: -28 dB<SLDR< -20 dB
Yellow: -20 dB<SLDR< -12 dB
Red : -12 dB<SLDR

$Z_e$ – bottom of each frame

Hydrometeor habits were verified by particle samples at the Mt. Washington

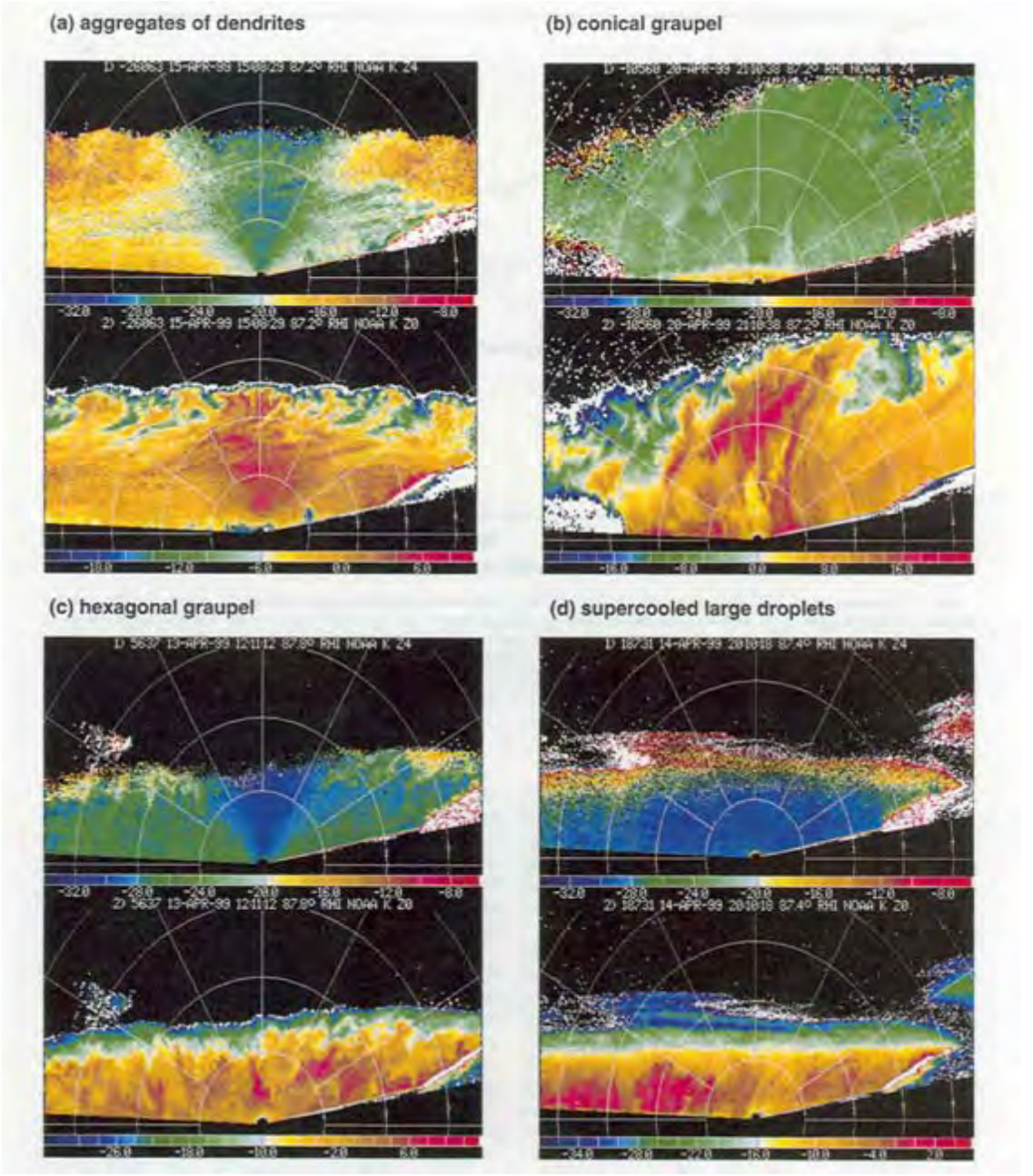


Depolarization by irregular ice crystals and supercooled drizzle (d)

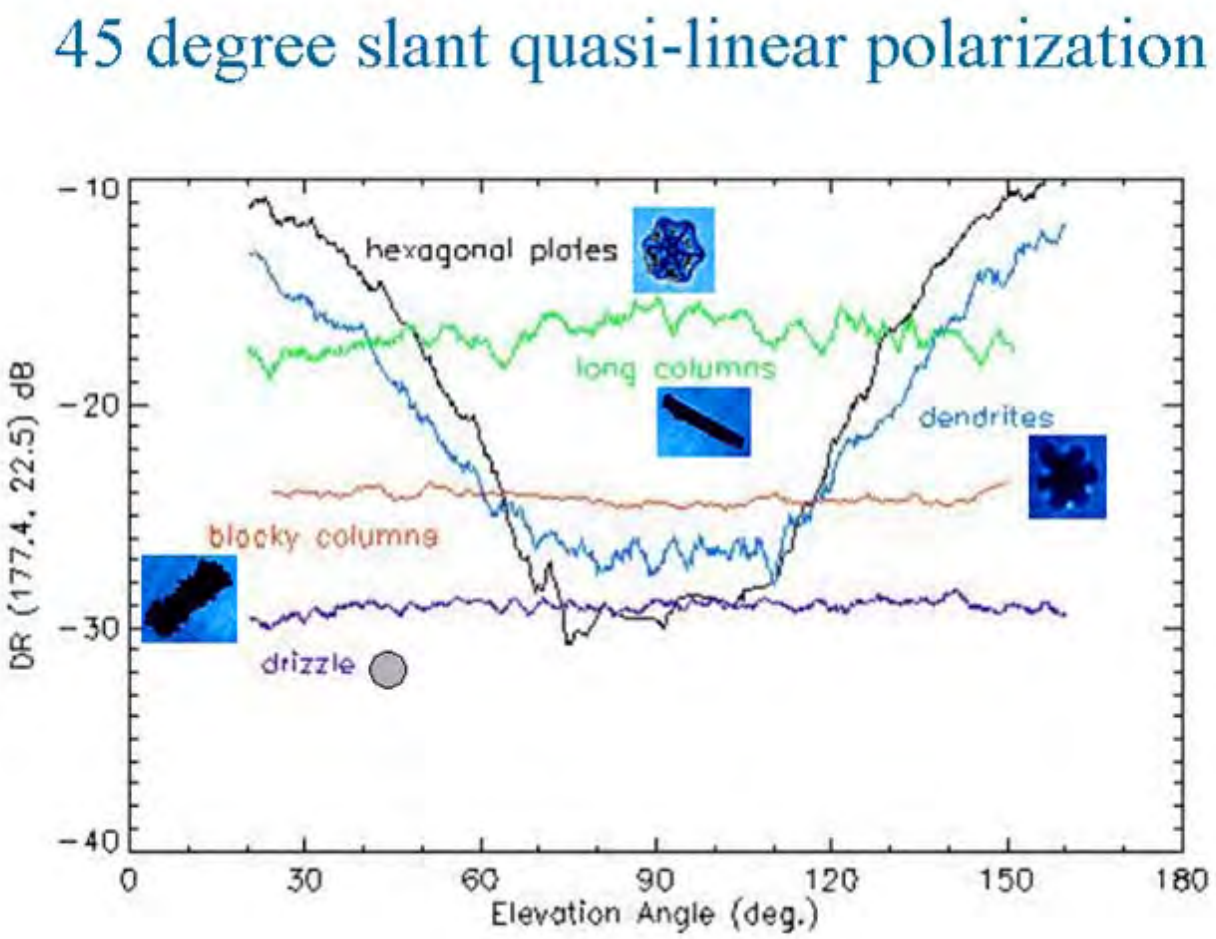
SLDR – top of each frame
Blue: SLDR < -28 dB
Green: -28 dB<SLDR< -20 dB
Yellow: -20 dB<SLDR< -12 dB
Red : -12 dB<SLDR

$Z_e$ – bottom of each frame

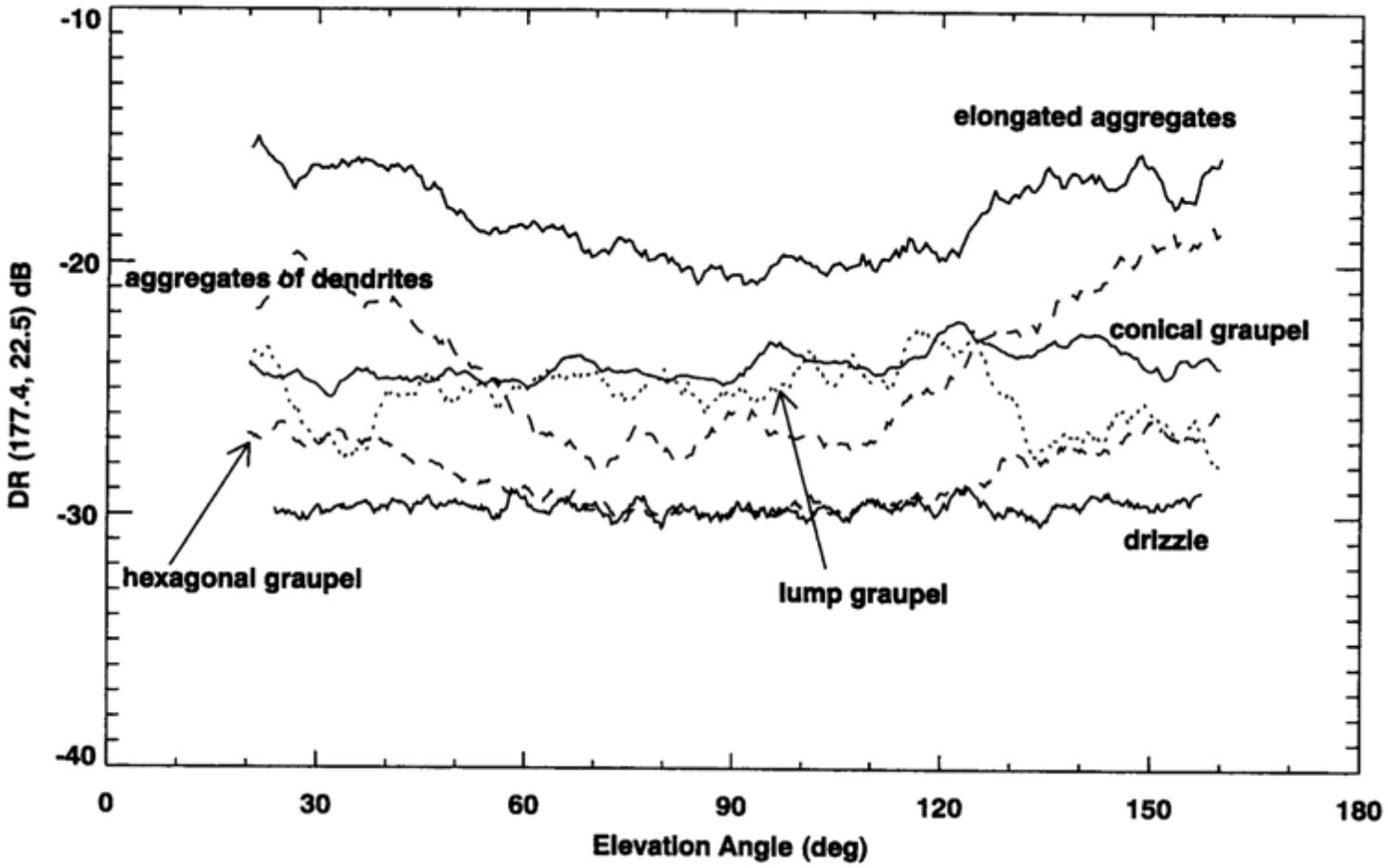
Hydrometeor habits were verified by particle samples at the Mt. Washington



SLDR versus elevation angle for pristine crystals

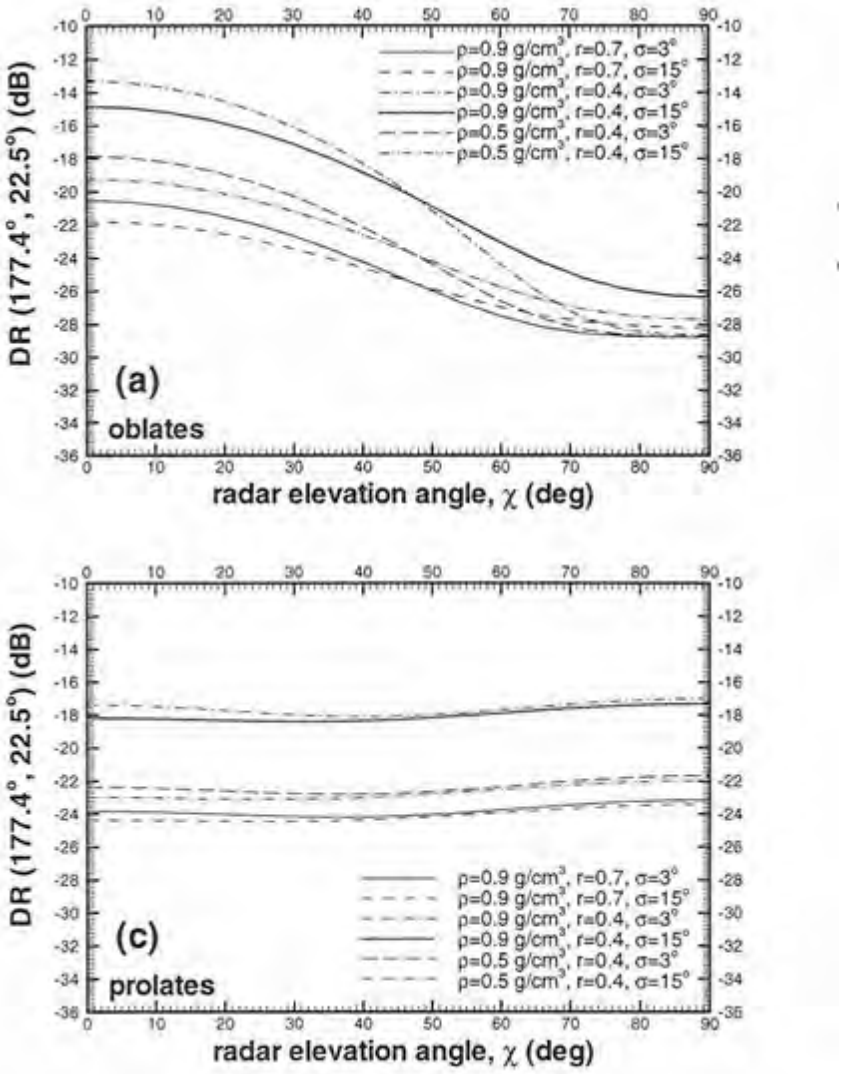


SLDR versus elevation angle for aggregate crystals



Depolarization measurements can be used not only to identify the predominant habit of ice hydrometeors but also to estimate their aspect ratio (if an assumption about the bulk density is made)

SLDR at an elevation angle of about 45$^o$ approximately does not depend on particle "wobbling" (i.e., $\sigma_\theta$) and is determined for a given type (prolate or oblate) by the aspect ratio and density



## A main polarimatric radar question to be addressed by StormVEx:

Could SLDR measurements at W-band (SWACR) be used for hydrometeor type identification and aspect particle ratio estimations in a way it was done at Ka-band in MWISP ?

Habit ID and particle aspect ratio retrievals can add a new dimension to ARM cloud retrievals.

## Issues that would complicate SLDR signatures at W-band:

-Stronger Mie scattering effects would affect SLDR values making aspect ratio -SLDR relations less pronounced compared to $K_a$-band

-Stronger differential propagation effects will also affect W-band SLDR increasing the apparent (i.e., observed) SLDR values

-Non-simultaneous measurements of co-cross polar echoes by SWACR (one receiver) might negatively impact quality of SLDR measurements