In situ validation of cloud radar-based retrievals of ice hydrometeor shapes

Oliktok Point AMF3 facility (October 2016)

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A fully polarimetric dual-frequency (K_a and W bands) SACR-2 was deployed at the AMF3 facility (Oliktok Point, AK)

SACR-2 measures: $Z_e$, $V_D$, LDR, $Z_{DR}$, $\rho_{hv}$, (CDR can be calculated from the measured variables)

A remote sensing method to infer ice hydrometeor shapes from SACR2 measurements
NCAR Video Ice Particle Sampler (VIPS) attached to a tethered balloon
Oliktok Point, 21 October 2016 case study

Ka-band SACR HRHI at az=135°, 00:22 UTC
Inferring shape parameters of atmospheric ice particles expressed as aspect ratios, $r$, from SACR2 measurements.

21 October 2016

0.5 km altitude

0.3 km altitude

red: from $CDR_p$

green: from $Z_{DR}$
Ground-based MASC estimates of particle aspect ratios (21 October 2016)

\[ r_{Ma} = \frac{< r_{M0} + r_{M1} + r_{M2} >}{3} \]

\[ r_{Ms} = < \min(r_{M0}, r_{M1}, r_{M2}) > \]

\[ r_{Mm} = \frac{< \min(D_0 r_{M0}, D_1 r_{M1}, D_2 r_{M2}) >}{\max(D_0, D_1, D_2)} \]
Examples of VIPS images of particles (21 October 2016)
VIPS estimates of PSDs (21 October 2016)

Period 1
VIPS $D_{mv} \approx 0.07$ cm
VIPS $D_{mean} \approx 0.026$ cm

Period 2
VIPS $D_{mv} \approx 0.08$ cm
VIPS $D_{mean} \approx 0.023$ cm

Period 3
VIPS $D_{mv} \approx 0.04$ cm
VIPS $D_{mean} \approx 0.024$ cm

Period 4
VIPS $D_{mv} \approx 0.05$ cm
VIPS $D_{mean} \approx 0.027$ cm

Period 5
VIPS $D_{mv} \approx 0.06$ cm
VIPS $D_{mean} \approx 0.022$ cm

Period 6
VIPS $D_{mv} \approx 0.07$ cm
VIPS $D_{mean} \approx 0.020$ cm
VIPS estimates of aspect ratios as a function of particle size (21 Oct 2016)
Intercomparisons of particle aspect ratios from radar retrievals (green and red) at 0.3 km VIPS (black squares) at ~ TBS altitudes, and ground-based MASC data (cyan line)

TBS is a convenient platform for deploying in situ microphysical probes allowing for close colocation of direct and remote (e.g., radar-based) estimates of cloud and precipitation microphysical parameters.

It would be useful if ice microphysical probes are deployed during more ARM TBS flights.