The Fully Polarimetric Architecture of the Ka-W SACR2

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Following the Scanning Radar IOP in May 2013 in Barrow, AK, the preliminary analysis of X-band polarimetric radar data has yielded significant information about the structure and processes of Arctic boundary layer and deeper frontal clouds [1]. Polarimetry has shown the distinctive capability of precisely identifying cloud volumes where processes such as depositional growth, aggregation and riming occur. Comparisons with NEXRAD observations from the January 2014 polar vortex outbreak suggest that some Arctic cloud processes occur in magnitudes that were not previously observed at the mid-latitudes.

Specifically, the planar growth of ice crystals in presence of sufficient atmospheric moisture emerges as an important ice formation mechanism. Firstly, because it indicates the presence of moisture aloft, secondly because it may induce (in presence of dendritic aggregation) higher reflectivity in the layer below and consequently higher snowfall rates at the ground. The exact characterization of planar crystal growth (dendritic vs. plate-like growth), and its microphysical developments (aggregation below and increased snowfall rates) require the development of radar systems capable of extracting all the polarimetric information available from the illuminated target.

The upcoming Ka-W SACR2 for Oliktok Point features a different polarimetric architecture with respect to previous SACR systems (implementing the LDR mode), since it implements the ATSR mode (Alternate Transmission Simultaneous Receive). Such polarimetric architecture makes available the full Covariance matrix and therefore all polarimetric variables: Z, ZDR, KDP, rho_hv, LDR, SLDR and CDR. The slower scan time (the radar implements a periodic block pulsing scheme) is largely compensated by the additional information available.

While ZDR has proven an excellent indicator of depositional growth and aggregation, information on planar crystal concentration (encapsulated in KDP at mm-wavelengths) has been scarce. The potential of KDP at Ka and W is evaluated for the estimation of ice crystal concentrations and for the discrimination of habit types (plates vs. dendrites vs. needles) at low grazing.