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Ka-Band Cloud Radar Comparison of Vertical and Slanted Polarization on Transmit

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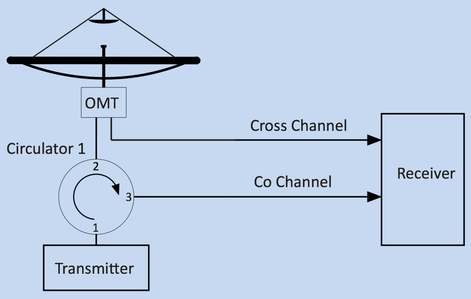
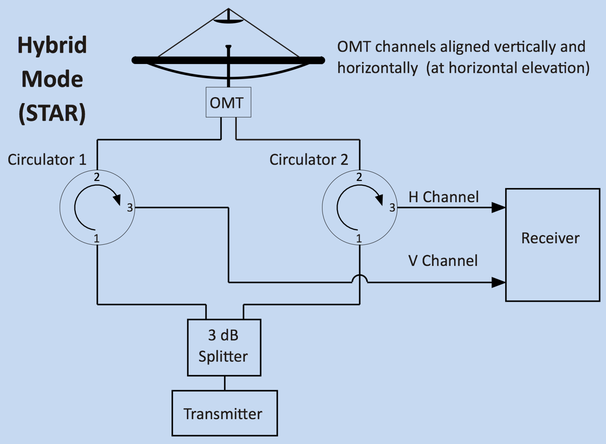
Abstract:
During the last years MIRA-35 Ka-band cloud radars where operated with different polarization configurations. Due to the high pulse power of the magnetron transmitter it is not possible to switch from pulse to pulse between the different configurations. The the different configurations where operated during different times and at different sites. Nevertheless after some years of operation the differences became obvious. These differences are shown on this poster with help of RHI scan examples from three different sites shown in the three columns.

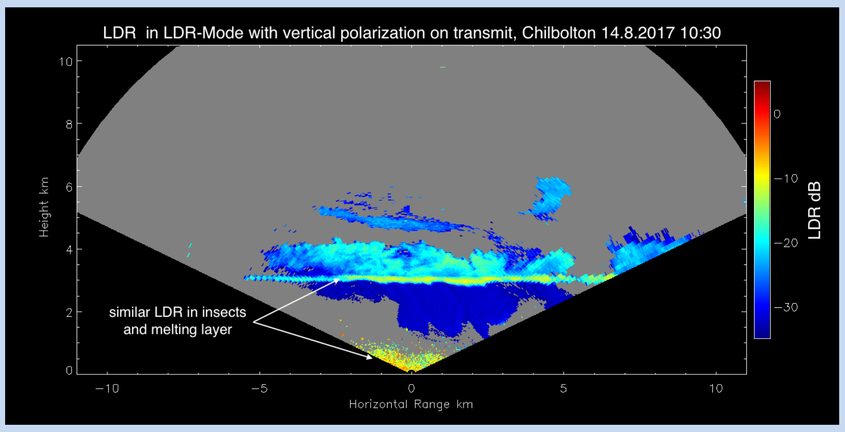


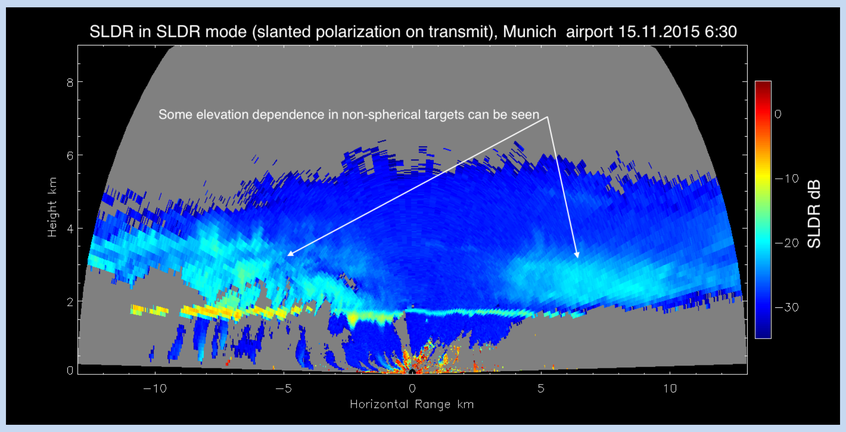
LDR Mode
with vertical linear polarized co-channel

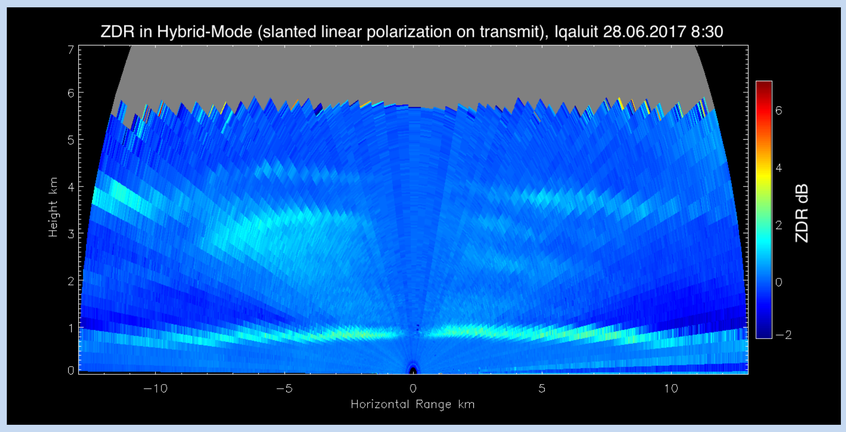
SLDR Mode
with 45° slanted linear polarized co-channel

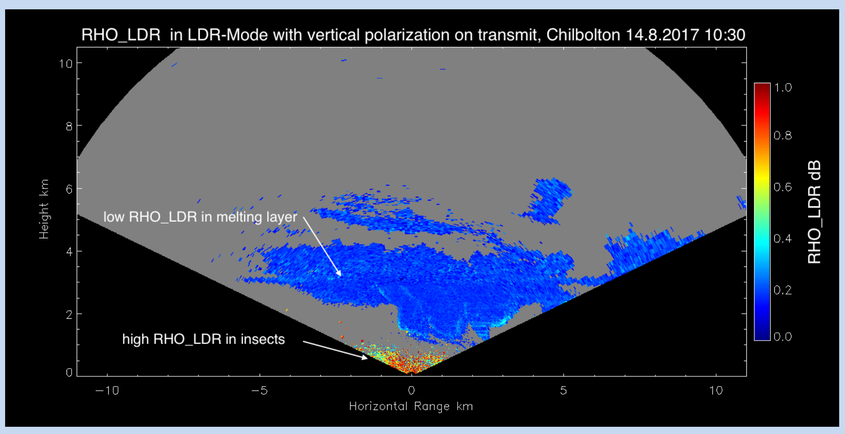


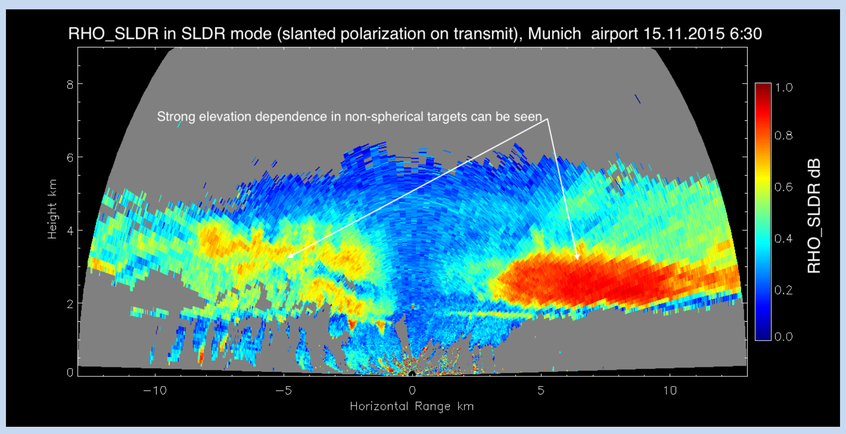
Hybrid Mode (STAR) the phase of transmitted signal in H and V was adjusted so that the transmitted signal has 45° slanted linear polarization

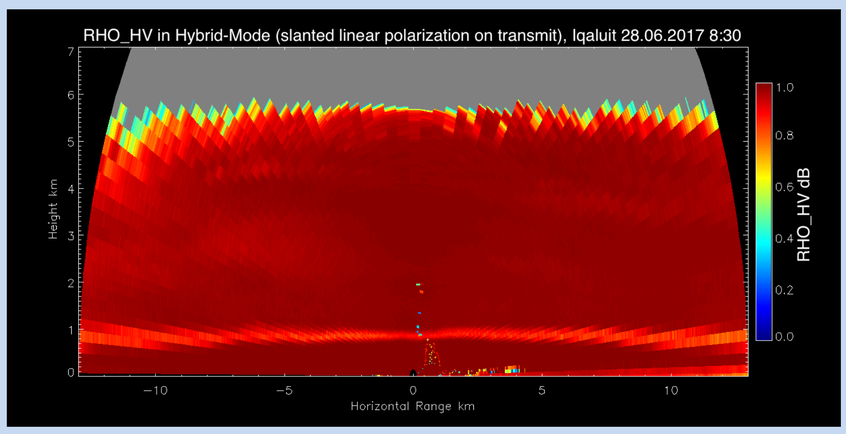


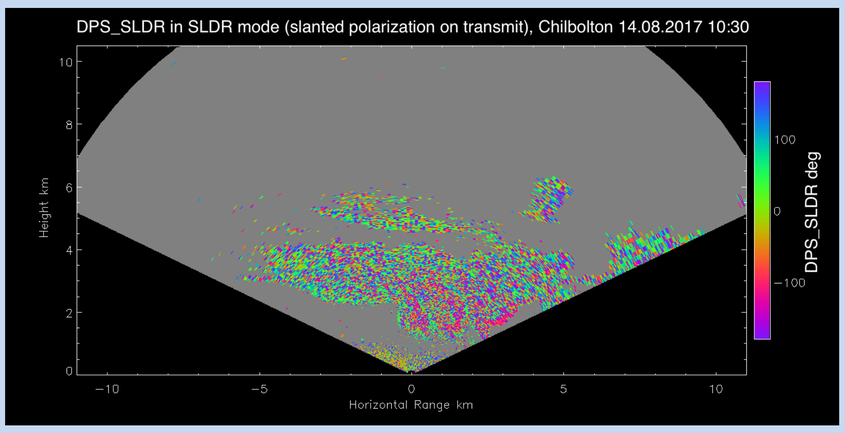


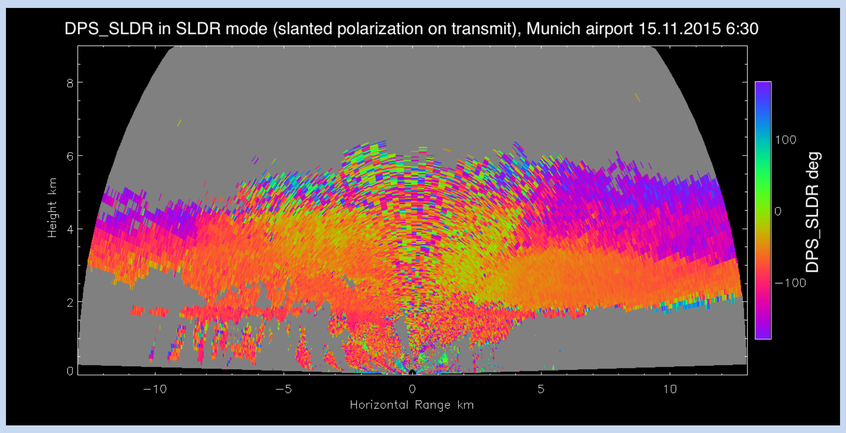


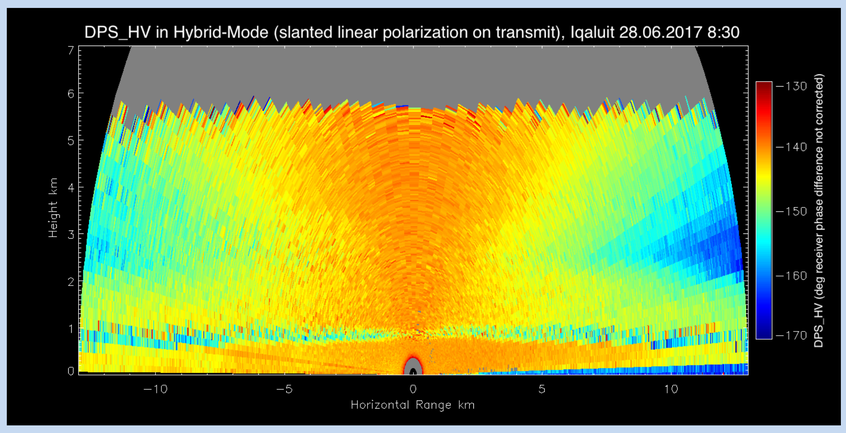




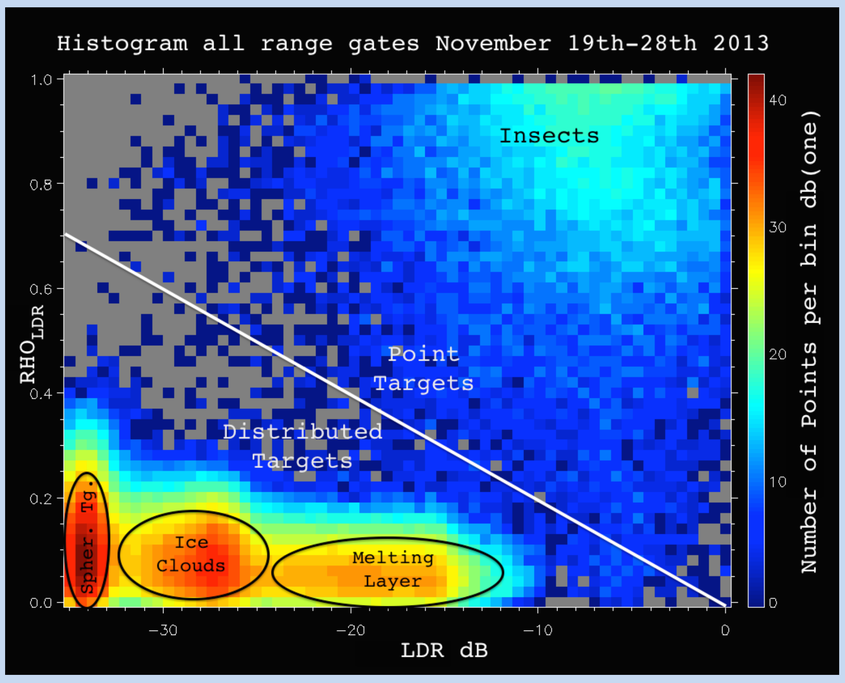








Advantage of LDR mode vs SLDR or hybrid mode:
Target classification is very simple:



This simple classification in the 2D plane formed by LDR and RHO_LDR does not work in case of SLDR mode. Specially RHO_SLDR frequently has high values in non-spherical targets at low elevations though they are distributed homogenously.

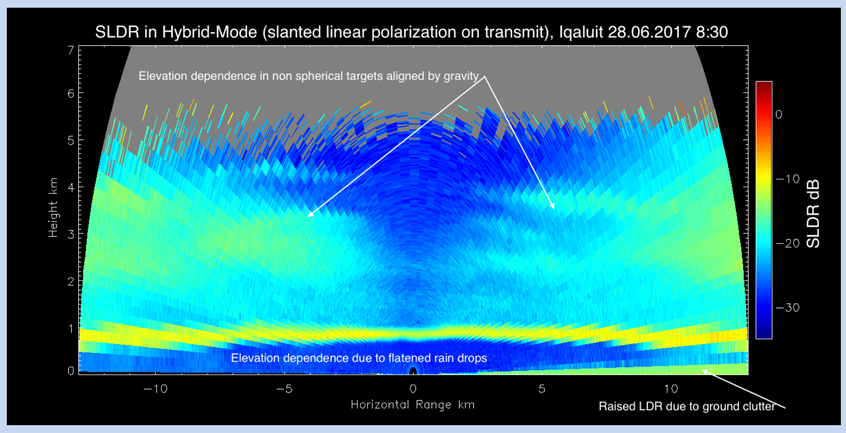
The difference between hybrid mode and SLDR mode is not so big as thought in the beginning. Because in either mode both channels are received simultaneously, it is possible to calculate not only the averaged power spectra but also the averaged complex correlation spectrum which reveals the phase difference (DPS) and the correlation (RHO) of the phases of both channels. With help of these three averaged spectra it is possible to make the basis transformation from the H/V-basis to the Co/Cross-basis and vice versa (see the SLDR image below which is calculated from from the hybrid mode measurements in the same column above).

Advantage of SLDR mode:
No phase adjustment of two transmit channels is needed to provide linear polarization (at least in the main beam elliptical components are very small)

The advantage of the Co- and Cross basis compared to H- and V-basis is that most of the information is condensed to *LDR and RHO_*LDR.

Advantage of the SLDR or hybrid mode vs LDR mode:
They are more sensitive to small deviations from spherical shape. Also in these modes KDP can be deduced.

Advantage of the hybrid mode:
Spherical targets (drizzle) can be used to calibrate the amplitude and phase difference between the H and V channel so that the SLDR deduced from the basis transformation has a minimum.



Acknowledgements: Thanks to our customers from the University of Leeds and Environment Canada who provided the data from left and the right column respectively.